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LIFE HISTORY OF THE AMAZON KINGFISHER

By ALEXANDER F. SKUTCH

In contrast to the large and varied assemblage of kingfishers in the Old World, only six species representing two genera occur in the Western Hemisphere. The Amazon Kingfisher (*Chloroceryle amazona*) is the largest of the four species which comprise its genus, and in the New World it is exceeded in size only by the two species of *Ceryle*. It is a stout bird about 11 inches in length, with a big, crested head and a short tail. The upper plumage of the male is deep metallic bronze-green, with a broad white collar across the hindneck and some white spots on the tail. The under plumage is largely white, varied by a broad zone of rufous-chestnut across the lower foreneck and chest. The female is similar but lacks chestnut on the underparts; the white of her breast is invaded by intrusions of green from the sides, which sometimes approach or even meet in the center. The Amazon Kingfisher agrees with the other four members of the family which breed in tropical America in the exclusive possession of chestnut, or the possession of a more extensive area of this color, by the male. It differs strikingly from the migratory Belted Kingfisher (*Ceryle alcyon*), in which only the female wears chestnut. The long, stout bill of the Amazon Kingfisher is black, the eyes are brown, and the short legs and feet are black.

This attractive kingfisher is distributed across continental tropical and subtropical America from southern México to Argentina, but it is absent from the Antilles. It prefers the broad, quiet, open waterways, although it establishes itself along broken, rushing mountain torrents if they are rather wide and contain scattered deep pools. Hence it is largely an inhabitant of the lowlands, where the rivers flow broad and deep and there are many winding lagoons. There are few records of its occurrence above 3000 feet; but along the Río San Juan at Aguacatán, in the Department of Huehuetenango, Guatemala, I encountered a single individual at 5700 feet above sea level, on November 13, 1934. The smaller Green Kingfisher (*Chloroceryle americana*), which hunts along narrow, rocky brooks, often in the depth of the forest, where the Amazon Kingfisher is never found, extends higher into the mountains and ranges farther to the north. I have seen it at 7000 feet in Guatemala, and Carriker (1910:493) records its presence at the same altitude in Costa Rica.

Like the other tropical American kingfishers, the Amazon Kingfisher never flocks and it is usually seen singly except in the breeding season. It is not unlikely, however, that male and female stay together on their territory throughout the year.

FOOD

The Amazon Kingfisher appears to subsist exclusively on fish as long as it can procure them. Sometimes it plunges directly into a stream from its perch on an overhanging bough, but at other times it hovers on vibrating wings while it sights the prey in the water beneath. So rapidly do its wings beat while it poises in mid-air that, to one standing directly in front or behind, its body seems to be suspended between two misty spheres. Suddenly the wings close, the hazy circles vanish, the kingfisher plunges swiftly downward, head foremost and breaks the surface with a splash; often it wholly submerges itself in the water. If the plunge has been successful, it promptly emerges with

the fish in its strong bill, flies to some convenient perch by the shore, shakes the drops from its plumage, and proceeds to beat the prey against the branch until its struggles cease, when it is swallowed head first. Although skilled in the art of fishing, this kingfisher misses more fish than it catches, and it is only because the bird will not be discouraged by repeated failures that it finally procures a meal. Often it waits long and patiently for a minnow to appear in a suitable position only to have the prospective victim dart away as it plunges toward it; the bird then planes off before striking the water and with a loud *kleck kleck kleck* returns to a perch for another attempt. Often, too, this kingfisher disappears beneath the surface only to re-appear with an empty bill. Once I watched an adult male make four unsuccessful plunges in succession in a stream which abounded in minnows.

Frequently while sitting on the bank of some clear, swiftly flowing, tropical river, I have watched the little silvery-scaled minnows gleam and flash in the current. As each at intervals turned on its side there was a bright, momentary gleam of silver, which vanished as soon as the fish righted itself and became almost invisible against the sandy bottom with which it blended so well. Are these the telltale gleams for which the kingfisher waits as it perches motionless on a streamside bough or hangs between two hazy circles of beating wings? If so, it must indeed be alert, for the gleam of silver from the minnow's side vanishes quickly. Sometimes the male kingfisher fishes in the dusk, well after sunset, and then, especially, the reflection of light from the scales of the minnows as they turn on their sides must be an aid to him. This late supper puzzled me until I learned how the sexes arrange their periods on the nest while they incubate (see p. 222).

VOICE

In addition to the hard rattles and reiterated sharp *kleck*'s typical of its tribe, the Amazon Kingfisher possesses a very different utterance, which is apparently what Hudson (1920:14) referred to as "*warbling* long clear notes, somewhat flutelike in quality." This is a pleasing performance, consisting of a clear "singing" note repeated at first in ascending pitch and with increasing tempo, until at last it falls rapidly in both pitch and speed. The kingfishers sometimes deliver this refrain as a greeting to their mates, and they may also utter it when alarmed by a threat to their young.

THE BURROW

In Central America, the Amazon Kingfishers breed in the drier part of the year, when there is less danger of low burrows in river banks becoming inundated or washed out by a sudden rise of the current. At this time the earth around the brood chamber is drier and more readily absorbs the nestlings' excreta, and the clear water favors fishing, which seems to become most difficult in the swollen, turbid current of periods of heavy rain. On our farm in El General, Costa Rica, 2500 feet above sea level, these kingfishers incubate in February and feed nestlings in March, the two months when the swiftly flowing mountain streams are lowest. Late broods are still fed in the burrow in April, when light rains have returned and the streams are slowly increasing in volume. In the Caribbean lowlands of Honduras and Guatemala, where I discovered four burrows in 1930 and 1932, digging began in February if not earlier, and one pair had nestlings a few days old by March 23. A replacement brood, however, did not hatch until early June, after the streams had become swollen and turbid.

All the burrows that I have seen were in river banks, with water flowing beneath or close in front of their doorways. In rocky banks where digging is difficult, the kingfishers may use the same tunnel for more than one year. Thus along the Río Peña Blanca in front of our house, in a high bank composed of rounded water-worn boulders and

pebbles of all sizes, closely packed together with the interspaces filled with blackish sandy loam, a burrow dug into one of the few available pockets of soil was occupied for nesting in three consecutive years, 1943, 1944, and 1945. In 1946 this pair of kingfishers bred in a new burrow about ten feet downstream from their old one. These tunnels were too crooked to see what they contained by looking in at the mouth, and they were too deeply embedded in the rocks to be opened. It is surprising that the kingfishers suc-

Fig. 1. Tela River in the Caribbean lowlands of Honduras, habitat of the Amazon Kingfisher.

ceeded in digging such long tunnels in this ground which is so full of closely compacted boulders and small stones that we find difficulty in making a hole big enough for setting a post or planting a small fruit tree.

More favorable for study were the burrows I found in the low, sandy banks of lowland streams in northern Central America. Here, where digging was relatively easy, and where the tunnels in the friable soil probably did not often last through the wet season, kingfishers of several kinds appeared to excavate fresh burrows each year. Those of the Amazon Kingfisher which I saw were situated from 17 to 38 inches below the tops of the vertical banks which they selected. A burrow beside the Río Morjá, a tributary of the Río Motagua in Guatemala, was already 3 feet long when found on February 22, 1932. By February 29 it was 3 feet 8½ inches in length, and by March 9 it measured 4 feet 10 inches, after which it ceased to lengthen. The excavation was accordingly

extended 22 inches in 16 days, or at the rate of 1.4 inches per day. If the kingfishers worked at the same speed from the beginning, they must have started their burrow in late January and spread their leisurely task over five or six weeks. After the tunnel ceased to lengthen, I made a small opening at the inner end and closed it with a board so that I could look in daily and record the laying of the eggs. The kingfishers then continued for a few days to enlarge the chamber at the end of the tunnel, but finally they abandoned their work and dug another burrow upstream. The latter, as is usual with replacement nests, progressed far more rapidly than the first and eggs were laid in it about the beginning of April. The abandoned tunnel was promptly claimed by Rough-winged Swallows (*Stelgidopteryx ruficollis*).

Although I spent a good many hours in sight of the earlier of these burrows beside the Río Morjá, the kingfishers worked at it in such a desultory fashion that I did not witness any serious digging. Both male and female entered for periods of one to three minutes, suggesting that they shared the labor of excavating, as was plainly evident in the case of a neighboring pair of Ringed Kingfishers (*Ceryle torquata*), who dug far more actively in my presence. While they are preparing to nest, the male Amazon Kingfisher sometimes gives his partner a fish, as I have seen on two occsasions, on April 4, 1932, in Guatemala and on February 18, 1946, in Costa Rica. When the female flies up and alights beside her perching mate, or if he settles beside her, he raises his wings above his back and holds them so for a few seconds as a sign of greeting.

In length and diameter, the burrows of the Amazon Kingfisher are intermediate between those of the smaller Green Kingfisher and the larger Ringed Kingfisher, which are often dug in the same banks. Four burrows which I measured were, respectively, 47, 56, 58, and 63.5 inches in length. All curved gradually to the right or left, so that it was impossible to see into the nest chamber when looking in at the entrance with a flashlight. The burrows also slope slightly upward, so that the space where the eggs lie is higher than the entrance, a provision that helps to keep the chamber dry. The enlargement at the inner end of the burrow was in one instance 10 inches wide, about 18 inches long, and 6½ inches high at the center. Although the mouth of this burrow was 17 inches below the top of the bank, the ceiling of the chamber was about 12 inches below the surface of the ground, hence it was easily reached by digging down from above. The tunnel which led to this chamber was 3¾ inches wide by 3¼ inches high. In an occupied nest, the tunnel has two well-marked parallel grooves made by the legs of the kingfishers as they shuffle in and out. Each side is also scored by a rather deep groove made by the bills of the birds while they excavate. When deserted burrows are occupied by Rough-winged Swallows, a multitude of fine, irregular scratches replace the parallel grooves made by the original owners. Neither Amazon, Green, nor Ringed kingfishers take any lining into their nest. They lay their eggs on the earthen floor, which soon becomes covered by a hard pavement composed of scales and bones of fish regurgitated by the incubating birds and pressed into the ground by their feet.

THE EGGS

Three burrows, which I opened in Guatemala and Honduras, each contained four eggs or naked nestlings. From one of these burrows the contents disappeared as the eggs were hatching, and about three weeks later the female completed a replacement set of three eggs. Two of these eggs had already been laid when I discovered that the burrow was again in use, hence I could not learn the interval which separated the laying of successive eggs. In Trinidad, Belcher and Smooker (1936:794) found a set of four eggs in a burrow only three feet long.

The eggs of the Amazon Kingfisher are short ovate and pure white, or sometimes

slightly tinged with buff. The dimensions of seven eggs, all laid by the same female in Guatemala, average 31.5 by 27.1 mm. Those showing the four extremes measured *32.1* by *27.8*, *30.2* by 27.0, and 31.4 by *26.6* mm.

INCUBATION

I studied the mode of incubation of this kingfisher at a nest beside the Río Morjá which contained four eggs within a few days of hatching. At 5:10 p.m. on April 18, 1932, I set a twig upright in the mouth of the burrow in such a manner that no kingfisher could enter or leave without pushing it over. When I arrived at 6:20 next morning, this marker told me that a bird had passed; probably it was the female arriving to begin her long night session. At a little before seven o'clock the male arrived and called. At 7:00 a.m. the female emerged from the burrow and flew upstream, and immediately afterward her partner entered. At 10:23 a.m. she returned, perched near the burrow, and called *keck keck*. Two minutes later the male, who had been inside continuously for well over three hours, flew out and went downstream, calling in his "singing" voice, whereupon the female promptly entered the burrow. At 11:00 I went off, leaving a twig standing upright in the doorway, but when I returned at 1:08 p.m. it was lying flat and I knew that some movement had taken place. At 2:17 p.m. the female left the burrow. Since it was she who had entered the burrow at 10:25 a.m., there had apparently been two change-overs while I was away visiting other nests, and the male had taken a turn on the eggs in the interval. Evidently the female now left because she heard her mate's voice, for he flew up as soon as he saw her emerge and at 2:22 p.m. he entered. At 5:48 p.m. the female returned and alighted in a tree leaning over the river near the nest, but after 19 minutes she flew downstream. Seven minutes later she returned, perched on a banana leaf near the burrow, and called *ket ket* in a low voice at measured intervals. This seemed to be the signal that she was ready to take over the nest, for the male at once emerged and flew downstream, at 6:14. After flying back and forth several times before the entrance, she went in at 6:18. I watched until it was dark, but she remained in the burrow.

When I returned at 5:54 the next morning, the upright twig assured me that no kingfisher had entered or left the burrow since the female had taken over the nest on the preceding evening. At 6:15 the male arrived in the perching tree. After waiting there for 12 minutes he flew down the river, but at 6:40 he returned. After another delay of 12 minutes he dropped down, poised a moment in front of the burrow, called a single *ket*, and in about half a minute his mate darted out. After flying back and forth several times before the doorway, he entered at 6:55. Setting up the sentinel twig, I hurried off to visit some other nests, hoping to be back before the male kingfisher ended his session. But when I returned at 9:20 a.m. I was disappointed to find that the twig had been pushed over. A kingfisher whose sex I could not determine was perching near the burrow, and when I opened the chamber I found the eggs still warm. Evidently the male had just come off the nest and my arrival had prevented the female's entry. I promptly waded the stream to my observation post on the opposite low shore. Although the female approached several times as though to enter the burrow, she did not go in, and the eggs remained unattended until the male returned at 11:40. Then there was no movement at the burrow until 5:43 p.m., when as the sun was setting the female arrived from downstream and called *keck keck* from a hidden perch. Two minutes later the male emerged after an uninterrupted session on the eggs of six hours and five minutes. The female entered for the night at 5:51 p.m.

Thus the Amazon Kingfisher's pattern of incubation differs greatly from that of the Ringed Kingfisher. In the latter, each sex is responsible for the nest for alternate periods

of 24 hours, so that the male sits through one night and the female through the next. The single daily change-over takes place in the morning between seven and ten o'clock, and thenceforth the oncoming partner is solely responsible for the eggs until the next morning. The Ringed Kingfisher breaks its long period of duty by a single outing in the afternoon, when for from half an hour to an hour the nest is unattended. But the female Amazon Kingfisher sat through consecutive nights, and it is fair to assume that she did so every night, for with this pair the cycle repeated itself every 24 hours, not every 48 hours as in the Ringed Kingfisher. On April 19 the male Amazon Kingfisher incubated for at least 7 hours and 17 minutes, including a morning session of 3 hours and 25 minutes and an afternoon session of 3 hours and 52 minutes. On April 20 the male incubated a total of about 8.5 hours, including his long afternoon session of 6 hours and 5 minutes. The female's desire to incubate by day was weak and when disturbed as she was about to return, she stayed away a long while and omitted her session entirely.

While the Ringed Kingfishers that I watched entered the burrow before the sitting partner came out, the Amazon Kingfisher announced, by calling *ket ket* or *keck keck* in a low voice at measured intervals, that it had arrived to take charge of the eggs. Although this sound was not loud, it seemed to reach the mate at the end of the burrow, who emerged almost at once. In its pattern of incubation, the Amazon Kingfisher resembles the congeneric Green Kingfisher. At a nest of this smaller kingfisher, the longest diurnal session that I timed lasted 3 hours and 33 minutes and was taken by the female. Sessions from 1½ to 3 hours in length were commonly taken by both sexes. In the Half-collared Kingfisher (*Alcedo semitorquata*) male and female also alternated on the eggs, sitting from one to two hours at a stretch and keeping them almost constantly covered. Because of the similarity of the sexes, it was not possible to learn which took charge of the nest through the night in this species (Moreau, 1944).

After studying the Amazon Kingfishers' mode of incubation, I understood why the male sometimes fishes in the dusk, after other diurnal birds have retired to roost. His mate relieves him from incubation late in the evening, and after fasting all afternoon he doubtless requires several fish to satisfy his hunger.

Like other members of their family, Amazon Kingfishers are strongly attached to their nests and remain at their posts in spite of danger. This was very evident at the burrows which I had prepared for study by making a small opening at the rear of the chamber, which after each visit was closed by a stone and covered with earth tightly packed. At first, when the stone was removed and light suddenly appeared at the wrong end of the burrow, the parent would fly out the front entrance, *klecking* wildly. After a few days it only retreated into the tunnel, where it stayed until the chamber was again closed. Toward the end of the period of incubation, however, it sometimes remained with the eggs and permitted me to touch it gently. But the kingfishers never, at any stage of the nesting, simulated injury nor made hostile demonstrations when I visited the burrow. Such displays could be of little value to a bird that nests in a burrow, for they are not likely to attract the attention of a predator with its head in the mouth of the tunnel or when digging a hole above the nest chamber. Moreover, the water which flows in front of most of the burrows is not a favorable stage for the act of "feigning injury."

The single burrow which I prepared for observation before the eggs were laid was deserted, and it was only through a fortunate accident that I was able to learn the length of the incubation period. At a neighboring burrow, apparently made by the pair of kingfishers which had abandoned the first burrow, I made a small opening at the back of the chamber a few days before the four eggs were pipped. The eggs or nestlings disappeared at about the time of hatching; I never saw the latter, nor can I guess what befell them. But I continued to look into this burrow from time to time, expecting it to be

occupied by the Rough-winged Swallows, which had been waiting for the kingfishers and motmots along this stream to leave their burrows so that they might begin their own belated nesting. Great was my surprise when, 19 days after the eggs of the ill-fated first brood had begun hatching, I looked into this burrow to find that the kingfishers had slightly lengthened and deepened their old nest chamber and that the female had already laid two eggs in it. On the following day, May 14, the third and last egg of this replacement set was laid. All three of these eggs were pipped at 9:00 a.m. on June 3. One had hatched by 10:30 a.m. on June 4, and at 9:30 a.m. on June 5 there were three nestlings. Thus the incubation period was 22 days. This may be compared with the period of 23 or 24 days of the Belted Kingfisher (Bent, 1940:115) and that of 19 to 21 days of the far smaller European Kingfisher, *Alcedo alcedo* (Kendeigh, 1952:224). It is also close to the incubation periods of the related motmots, which in the case of the Blue-throated Green Motmot (*Aspatha gularis*) is 21 days.

THE NESTLINGS

The method of emergence from the shell of kingfishers and motmots is different from that of other small birds I have observed. It is the rule, I think, for the chick of most species to hammer at a small area of the shell until a break is made. The chick then rotates slowly in the egg in such a manner that the head, bent under a wing, moves backward, and the rhythmic upward thrusts of the bill continually bring the hard egg-tooth in contact with the edge of the lengthening hole. The result is that the large end of the shell is cut off along a line transverse to the long axis. When this line of separation has lengthened sufficiently, the struggles of the imprisoned bird break off a symmetrical cap, and the nestling wriggles forth. But in kingfishers and motmots the chick moves its head in such a fashion as to crack the shell in a number of points scattered irregularly over an entire quadrant between the greatest circumference and the thicker end of the egg. The cap which is finally pushed off is markedly assymetrical and is separated from the body of the shell by an oblique rather than a transverse line. Young kingfishers take between one and two days to emerge from the shell.

To follow the development of the young, let us return to my first nest, which early in May, 1930, I found in a low, sandy bank of the Tela River in northern Honduras. To explore the interior of the burrow I dug down to the nest chamber from the level ground. After I had removed a little earth, the female kingfisher, disturbed by the noise above her, darted out from the front of the tunnel and uttered a little rattle by way of protest as she flew down the river. Her voice was not raised above the tone she ordinarily used when cruising above the stream. The Chipsacheery Flycatchers (*Myiozetetes similis*), who were feeding three newly hatched nestlings in their domed nest among the branches of a dead tree that had fallen into the river in front of the burrow, were far more troubled by my activities than the kingfisher herself.

After removing a few more shovelfuls of earth, I broke through into the burrow. The widening aperture revealed four, naked, squirming nestlings, who barely escaped the rain of loosened sand that I vainly tried to stem. They had apparently just hatched, and two of the empty shells lay on the floor of the chamber beside them. Not the slightest trace of down shaded their pink, peculiarly transparent skin. They could not by any standard be called pretty, least of all when viewed in profile. Two black knobs, extending above the forehead, indicated the points where their sightless eyes were buried beneath the skin. They were decidedly prognathous, the lower mandible projecting about two millimeters beyond the upper. They could already stand upright and even walk unsteadily, supporting themselves on the abdomen and the entire tarsus. Their heels were covered with a thick pad of skin roughened by numerous small tubercles, which served

to protect them from abrasion through the long days when the young groped around on the sandy floor of their dark nursery. They uttered a little, high-pitched, buzzing or sizzling sound when I touched them.

After carefully uncovering the nest chamber, I roofed it with a pane of glass, above which I fitted a wooden lid to exclude the light. The excavation was further concealed with boards laid across at ground level and covered with leaves and litter. Only because it is almost impossible to make kingfishers abandon their young did this pair continue to brood and feed them in their elaborately modified nest. The far simpler procedure of making a small opening at the rear of the chamber and closing it with a stone is the only one which the birds are likely to tolerate before their eggs have hatched. Also, this method exposes the nest to less risk of discovery by predatory animals and prying men.

Fig. 2. Nestling Amazon Kingfisher nine days old; near Tela, Honduras, May 15, 1930.

However, this mode of opening the burrow has the disadvantage that, when the stone at the back is removed and light suddenly enters the aperture, the young kingfishers, even when newly hatched and with tightly closed eyes, retreat forward into the tunnel, where it is difficult if not impossible to reach them. When the entire chamber is uncovered, it is far easier to catch the nestlings before they can escape into the tunnel. Sometimes, when I lifted the lid over the kingfishers' nest, I found one of the parents brooding the nestlings, and it flew up against the glass before retreating toward the mouth of the burrow. Never until I had this close view from above did I appreciate how intensely green their upper plumage is.

The two parents shared nearly equally in the care of their progeny. As far as I could determine, they brought them nothing but fish, which were delivered and apparently swallowed whole. They showed a nice discrimination in adjusting the size of the minnows to the capacity of their nestlings. When the latter were only a few days old, the parents brought minnows so small and slender that, when carried lengthwise, they were almost concealed by the bill. Such small fish were also carried athwart the bill. The parents gradually increased the average size of the minnows until, when the nestlings were feathered, they brought many which were longer than their bills and quite thick. These large fish were always carried lengthwise of the bill, with the head pointing inward. If I happened to be in sight when a parent arrived with food, it delayed on some branch overhanging the stream, repeatedly elevating its head and tail simultaneously with a jerky motion, as though the two were attached together by a hinge as in some mechanical toy and could not move independently. Each time its head and tail went up the kingfisher uttered a sort of nasal click.

When the nestlings were about five days old, their eyes began to open, and the black rudiments of the feather sheaths were visible through their transparent skin. Two days later their eyes were fully open. They were at least 11 days old before the upper mandible approached the lower in length. At the age of 12 or 13 days their body feathers began to escape from the horny sheaths, which had grown very long. Now for the first time they tried to bite when I picked them up. When about 19 days old they were well clothed with plumage and even had rather prominent crests. They had wholly outgrown their ugliness, and they had already acquired the parental habit of jerking up the head and tail simultaneously as they stood on the ground. I believed that I could distinguish

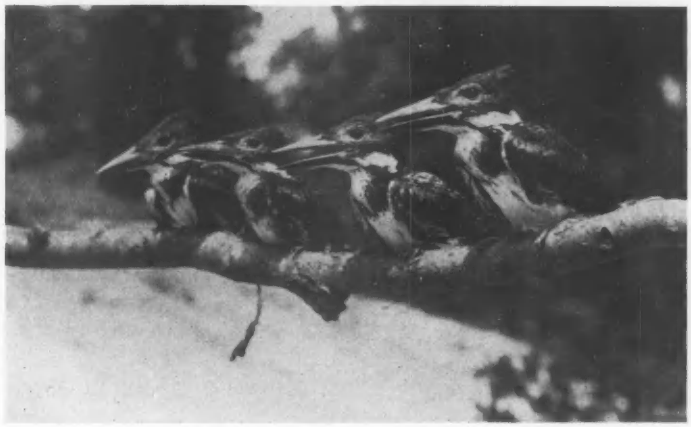

Fig. 3. Nestling Amazon Kingfishers, 18 days old; near Tela, Honduras, May 24, 1930.

their sexes. All four of the young bore a close resemblance to the female. They had broad peninsulas of dark green projecting from the sides into the white of the breast; but the white pectoral feathers of two of them were perceptibly tinged with chestnut in the position of the band across the male's breast, and these were probably males. Their upper mandibles were now longer than the lower ones. They did not attempt to fly until they were about 24 days old, and even then they could do no more than flutter. They now defended themselves with spirit, biting my fingers whenever I gave them an opportunity.

Kingfishers, like motmots and jacamars, take no measures for the sanitation of their burrows. The decomposition of the nestlings' nitrogenous wastes sometimes generates enough ammonia to make one's eyes smart when placed close to an opening at the rear of the nest chamber. The indigestible bones and scales of fish are regurgitated by the nestlings and add to the accumulation of such material already begun by the parents while they incubated the eggs. Maggots crawl in this debris on the floor of the nursery and green flies buzz out when the burrow is opened. However, the light, sandy soil which kingfishers prefer for their burrows absorbs much of the offensive matter and prevents the chamber from becoming unbearably foul. I noted in one instance that the chamber was somehow enlarged while it contained nestlings, and the earth dug or worn from the walls covered some of the filth on the floor. In dry, porous soil the burrow remains surprisingly clean throughout the long period of occupancy by the four nestlings. The young kingfishers themselves, except for their feet and bills, are usually as neat and clean as though they had just been washed and brushed. They rise superior to their environment.

Twenty-eight days after I found the newly hatched nestlings, I paid them a visit and placed a female on the ground beside me while I held one of the males. The female parent was flying over the river close by and the young female answered her loud calls in a much weaker voice. Finally I noticed that I had placed her in a spot where fire-ants swarmed and I tried to pick her up, but she would no longer submit to handling. Her wings beat, and she rose from the ground and traversed the river without difficulty. She alighted in a small willow tree on the opposite shore. I started to cross the channel on a fallen log to retrieve and return her to the burrow; but now that she had tasted freedom

Fig. 4. Nestling Amazon Kingfishers, 24 days old and fully feathered; near Tela, Honduras, May 30, 1930.

in the sunlight, she would not permit herself to be caught and replaced in the dark subterranean nursery. Before I was halfway over, she took wing for a much longer flight and rose into a tall willow tree, followed by the female parent. This juvenile had been long in discovering the use of her wings, delaying a week after her feathers had seemed sufficiently expanded to support her in the air, but finally flight had come to her all at once. The importance of the long nestling period, and the sudden development of the power of flight after the youngster is well grown, is apparent in a bird whose burrow frequently opens on a wide expanse of river or lake. A weakly fluttering departure from the nest, such as many fledglings make, would, in this situation, bring the bird to a premature and watery grave.

When I approached the river next morning, the alarmed cries of the parents told me that the rest of the brood was on the wing. When I uncovered the burrow it was empty. Only a single, silvery-scaled minnow, probably taken in after the last fledgling had flown, lay upon the sandy floor. The young had remained in the burrow 29 or 30 days, several days less than those of the larger Ringed Kingfisher, whose nestling period is 35 days or more. But the African Half-collared Kingfisher leaves the burrow when about 27 days old (Moreau, 1944). I watched one of the young Amazon Kingfishers diving for fish, twelve days after it left the nest, but it caught nothing.

The brood whose incubation period I determined was exceptionally late. Because the parents had deserted their first burrow after I opened it, their replacement brood did not hatch until early June, when most young kingfishers were already on the wing. The rainy season now set in and the muddy flood waters of the Río Morjá rose to within a foot of the mouth of their tunnel. Fishing must have been difficult in the swift, beclouded stream; but the parents somehow managed to catch enough minnows, and in July they were feeding at least two of their young in the trees along the bank.

BATHING

Although the burrows of the kingfishers in the high, stony bank of the Río Peña Blanca are far less favorably situated for study than those I had found earlier in the almost stoneless banks of lowland streams in northern Central America, I witnessed here one phase of behavior which I had not previously observed. After entering the burrow with large minnows for older nestlings, the parents regularly bathed in the river. Sometimes on emerging from the tunnel the female would plunge directly into the water. Then she would fly to a rock projecting above the shallow, dry-season current in the middle of the channel and take additional baths. More often the parents would go first to a boulder, from whose top they dipped into the stream. As far as I saw, they never omitted these ablutions after they came out of the burrow. The number of dips they took after a visit to the nest varied from two to five. The kingfishers did not completely immerse themselves in the shallow water. After the last plunge in the series they sometimes preened their plumage as well as they could with their great bills and shook their wings and tail. Then they flew up- or down-stream searching for more fish. Since the water where they most often bathed flowed shallowly over a rocky bottom, it is not likely that these plunges were for the purpose of catching fish, for I never saw them capture any on these occasions.

Lockley (1953:69) observed that Puffins (*Fratercula arctica*) regularly bathe in the sea after a spell in the burrow with the egg. Moreau (1944) wrote of the Half-collared Kingfisher in Tanganyika Territory: "About the middle of the fledging period the tunnel must have got into extremely foul condition, because liquid faeces were constantly oozing from its entrance. The old birds evidently disliked this; it became their invariable custom when they emerged to plunge repeatedly into the water to clean themselves. Usually they did this four or five times, but once eighteen plunges were recorded. A similar observation on the European Kingfisher . . . . has been recorded by Ris."

I never examined a burrow of kingfishers, motmots, jacamars or puff-birds in such a foul condition as Moreau described. As already noted, the burrows of the Amazon Kingfishers that I studied in northern Central America were, despite their ammoniated atmosphere, surprisingly clean, considering the parents' inattention to sanitation. Perhaps for this reason the old birds were never seen to bathe after emerging from them, although it is not impossible that they did so out of sight around a bend in the river. Although I could not open the burrows beside the Peña Blanca for examination, it is probable that in this rocky ground the waste matter did not drain off as well as in the sandy loam along the northern rivers. Considering the number and size of the rocks in this bank, it would not be surprising if one of them formed the floor of the nest chamber, and such a bottom would be impervious to liquids, hence the greater need for bathing. It is probable that only their feet, and to some extent their under plumage, were soiled as they shuffled in and out of the burrow; and these were the parts which the kingfishers seemed to wash by their partial immersions in the stream.

I found no indication of second broods in the Amazon, Green, and Ringed kingfishers, and Bent (1940:114) stated that the Belted Kingfisher rears only one brood in a

season. Although the American kingfishers are, as far as we know, single-brooded, the African Half-collared Kingfisher rears two broods between September and March, in the "short rains" and subsequent hot, dry season (Moreau, 1944).

SUMMARY

In Central America the Amazon Kingfisher lives chiefly along the broader and deeper waterways. It is most abundant in the lowlands below 3000 feet, but it is occasionally found as high as 5700 feet. Except in the breeding season, it is solitary.

As far as observed, this kingfisher subsists exclusively on fish, for which it plunges directly from a perch or from a hovering station above the water. Often it misses its prey, and most of its dives seem to yield nothing.

In addition to rattles and loud *kleck*'s, it has a more songlike performance consisting of a single soft, clear monosyllable uttered with increasing pitch and tempo until it reaches a climax, then falling rapidly in both pitch and speed.

These kingfishers breed chiefly in the drier months early in the year, when burrows in river banks are not likely to be washed out or inundated and clear water facilitates fishing. Burrows were found only in the banks of streams. In very rocky banks, where digging is difficult, the same tunnel may be used for at least three successive years, but in sandy banks new burrows seem to be dug each year. Excavation may begin in January and proceed very slowly. Over a period of several weeks, one burrow was lengthened at the rate of only 1.4 inches per day. Apparently both sexes dig the burrow.

Burrows measured in Central America ranged from 47 to 64 inches in length. They are usually more or less curved, so that it is impossible to look into the nest chamber from the front. This enlargement at the inner end of the tunnel is not lined, and the eggs are laid directly on the earthen floor.

Three nests each contained four eggs or nestlings. A replacement set consisted of three eggs. The eggs are pure white or, exceptionally, faintly buff.

The female incubates through the night, and by day the two sexes alternate on the eggs. At one nest the male did most of the diurnal incubation, taking a fairly long session in the early morning and in the afternoon a longer one, which in one instance lasted six hours and five minutes. The female relieved him late in the evening, and he fished for his supper in the dusk.

At one nest the incubation period was 22 days.

The nestlings are hatched without any trace of down or feathers on their pink, transparent skin. Their heels are equipped with tuberculate pads. Their protruding eyes are tightly closed and the lower mandible projects beyond the upper. The latter grows faster and equals the lower mandible in length about 11 days after hatching. The pinfeathers grow long and the contour feathers begin to escape from them when the nestlings are about 12 days old. At the age of about 19 days the young are covered with feathers, but they can scarcely fly even when 24 days old.

Both parents feed the young with minnows whose size is adjusted to that of the nestlings, so that the fish brought are increasingly larger as the young kingfishers grow. Although the kingfishers are devoted parents, sometimes staying with their eggs or nestlings and permitting themselves to be touched when their burrow is opened, they never make hostile demonstrations nor give distraction displays.

No provision is made for the sanitation of the nest, which is fouled not only by the droppings of the nestlings but by an accumulation of regurgitated fish scales and bones begun by the incubating parents and augmented by the young. Despite the ammoniated atmosphere produced by the decomposition of these nitrogenous wastes, the burrow remains fairly clean if it is in rather dry, porous soil. Parents feeding older nestlings in

a tunnel in a very rocky bank plunged repeatedly into the stream to bathe each time they came out of the burrow, but kingfishers with burrows in light, sandy soil were not seen to bathe.

From one nest the young left when 29 or 30 days old; at this time they flew well. Apparently only a single brood is reared each year in Central America.

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El Quizarrá, San Isidro del General, Costa Rica, December 3, 1956.

THE STATUS OF THE CHACHALACAS OF WESTERN MEXICO

By ROBERT T. MOORE and DON R. MEDINA

The chachalacas of México can be divided into two natural groupings; the larger "*poliocephala-wagleri*" types of western and central México, and the smaller "*vetula*" types of southern and eastern México. In the main they are allopatric, a fact which has undoubtedly contributed to the diversity of opinion regarding their relationships.

In their review of *Ortalis vetula,* Miller and Griscom (1921) gave no indication that they believed the similar species *O. poliocephala* or *O. leucogastra* were closely related to it. They did, however, make extensive comments on the similarity of *O. vetula* and *O. ruficrissa* of Colombia. Later Griscom (*1932:104*) considered *leucogastra* to be "an obvious representative of *vetula*," and reduced it to subspecific status. Then Griscom (1934:372) joined *O. poliocephala* with *O. vetula* with the comment that he could "see no reason for keeping this bird specifically distinct . . . ." Peters (1934), Hellmayr and Conover (1942), and Ridgway and Friedmann (1946), without additional comment, followed Griscom in the union of these forms. However, more recently Wagner (1953) considered *poliocephala* to be a distinct species but retained *leucogastra* as a subspecies of *vetula*. Aldrich and Duvall (1955) excluded both *poliocephala* and *leucogastra* from the races of *O. vetula*. Unfortunately the nature of their publication did not permit them to discuss the taxonomy of the forms involved, and neither the reason for this exclusion nor the status of these forms was considered.

Whether or not *leucogastra* has reached a degree of differentiation sufficient to deserve recognition as a species we do not at present feel qualified to say; however, certain characteristics of this form lead us to believe that it may be separate. *O. leucogastra* and *O. v. vetula* evidently come into contact in southern Chiapas. Martín del Campo (1942) cites a record of *O. v. jalapensis* [= *O. v. vetula* (Ridgway and Friedmann, 1946:34)] taken by Dr. Helmuth O. Wagner at Mapastepec, Chiapas, while Friedmann, Griscom, and Moore (1950:70) give the range of *leucogastra* in Chiapas as "Mapastepec to Benito." If both of these records are correct, a point of contact is established and intensive field work in the area will undoubtedly throw light on the relationship of this questionable form.

Specimens in the Moore collection, taken by Chester C. Lamb, and also specimens in the collection of Allan R. Phillips from the northwestern portions of Colima and Jalisco, respectively, have convinced us that certain changes in the nomenclature of the west coast chachalacas are necessary. First, we follow Wagner and Aldrich and Duvall in the exclusion of *poliocephala* as a race of *O. vetula* and suggest with them that it be regarded as a species. Second, the discovery of a population in northwestern Jalisco connecting *O. wagleri* and *poliocephala*-like birds leads us to conclude that these forms are conspecific. Finally, we find that there is a distinct population of *O. poliocephala* from Colima north through western Jalisco which we propose to name

Ortalis poliocephala lajuelae subsp. nov.

Type.—Adult female, no. 36629, collection of Robert T. Moore, Occidental College, from Lajuela, Colima, 1 mi. SE Cihuatlán, Jalisco, México, altitude 75 feet, taken on April 20, 1943; collected by Chester C. Lamb, original no. 8077.

Diagnosis.—Similar to *O. p. poliocephala* but general coloration darker; breast Saccardo's Olive (less ashy); abdomen and thighs darker, more or less heavily washed with Ochraceous Buff to Apricot Buff; flanks and undertail coverts Ochraceous Tawny to Cinnamon Rufous; tips of the rectrices much darker, especially on the dorsal surfaces, proximal portion Chestnut, fading to Ochraceous Buff dis-

tally, the ventral surfaces somewhat lighter; ground color of rectrices darker, with a distinct blue-green sheen (capitalized colors are from Ridgway, 1912).

Lajuelae can be distinguished from *wagleri* by its lighter coloration, much reduced crest and the markings on the tips of the rectrices. In *O. p. wagleri* the central pair of rectrices is uniformly colored, the next lateral pair indistinctly tipped and the lateral pairs well marked. The central pair is indistinctly marked and all the lateral pairs are well marked in *O. p. poliocephala* and *O. p. lajuelae*.

Lajuelae can easily be distinguished from the races of *O. vetula* by its much larger size.

Measurements.—The measurements of *O. p. lajuelae* do not differ significantly from those of *O. p. poliocephala* (see table 1).

Range.—From western Colima north through western Jalisco to the vicinity of Puerto Vallarta where it intergrades with *O. p. wagleri*.

Table 1

Measurements of adult males of *Ortalis poliocephala* and *Ortalis vetula* in millimeters[1]

	Wing	Tail	Culmen	Tarsus
O. p. lajuelae	243–249 (245)	282–292 (288.3)	28.1–29 (28.7)	68.4–70.6 (69.7)
O. p. poliocephala	235–282 (248.4)	263–310 (283.2)	26–33 (29.8)	68–77 (71.5)
O. p. wagleri	250–289 (262.7)	269–307 (287.1)	25–28 (26)	69–80 (74)
O. p. griseiceps	256–272	277–279	26–27	67 .....
O. v. mccalli	197–219 (208.2)	225–255 (239)	22–27 (25)	55–63 (60)
O. v. vetula	177–202 (192.8)	197–225 (214.3)	24–28 (25.9)	58–65 (62)
O. v. pallidiventris	173–204 (188.5)	201–226 (214)	24–28 (25.5)	56–66 (61.3)
O. v. intermedia	181–190 (186.6)	225–258 (237)	23.5–27 (25)	58–65 (61.8)
O. v. vallicola	207–214 (210.3)	234–252 (245.3)	.....	.....
O. v. plumbiceps	189	238	25	66 .....
O. v. deschauenseei	208	225	25.5	58 .....
O. v. leucogastra	207–220 (215.6)	197–212 (202.6)	27 (27)	52–55 (53.6)

[1] Extreme and average measurements from Ridgway and Friedmann (1946) except for *O. p. lajuelae*.

The type locality of *O. p. poliocephala* was restricted to La Salada, Michoacán, by Ridgway and Friedmann (*loc. cit.*); however, recently Stresemann (1954:89) correctly pointed out that Wagler's description was based on material collected by Ferdinand Deppe at "Real Arriba" [= Real de Arriba, México]. The latter is therefore the type locality.

There is good evidence of north-south and west-east color clines when the species as a whole is considered. *O. p. wagleri* of Sinaloa and Nayarit represents the dark extreme, changing rather abruptly to the somewhat intermediate but distinct *lajuelae* of western Jalisco and Colima. Specimens of *poliocephala* from the coastal lowlands of Guerrero and Oaxaca are on the average darker and slightly smaller than the specimens of the same race from higher altitude in west-central and eastern Michoacán. The most pallid specimens examined come from southern Puebla (10 mi. S Tehuitzingo, altitude 4000 feet).

Specimens examined.—*O. p. lajuelae:* Colima: 1 ♂, 1 ♀, Lajuela; 1 ♀, Manzanillo. Jalisco: 1 ♂, Puerto Vallarta (Arroyo Las Estacas); 1 ♂, 1 ♀, Carboneras, NE (Guapinole +) El Pitillal, N Puerto Vallarta.

O. p. poliocephala: Jalisco: 1 ♀, Los Masos. Michoacán: 2 ♂, 1 ♀, 5 mi. NE Apatzingán; 1 ♀, Tafetan. Guerrero: 3 ♂, Cuajinicuilapa. Oaxaca: 1 ♀, Ostuta River, 5 mi. W Zanatepec; 1 ♀, Río Patos, 6 mi. W Tapanatepec; 2 ♂, Punta Paloma, 10 mi. S Tapanatepec. Puebla: 1 ♂, 1 ♀, Rancho Papayo, 10 mi. S Tehuitzingo.

O. p. wagleri: Jalisco: 1 ♀, Bahía de Banderas. Nayarit: 1 ♂, ½ mi. E San Blas; 1 ♂, Arroyo de Obispo, 5 mi. NW Chapalilla; 1 ♂, 2 ♀, Río Las Canas, 12 mi. N Concha in Sinaloa. Sinaloa: 1 ♂, 2 ♀, Río Las Canas, 12 mi. N Concha; 1 ♂, Rancho Santa Bárbara, 20 mi. NE Rosario; 1 ♂, Chele; 1 ♀,

Iguana on Río Presidio, 3 mi. N San Marcos; 1 ♂, 1 ♀, Sierra Palos Dulces, 15 mi. WSW Cosala; 1 ♂, Palmar; 1 ♂, San Lorenzo; 1 ♂, Arroyo Guayabito, 15 mi. E Quila; 6 ♂, 3 ♀, El Molino; 1 ♀, Rancho El Padre, 3 mi. S Chicorato; 4 ♂, Yecorato. Durango: 1 ♂, Rancho Guasimal, on lat. 25°, 6 mi. W Birimoa.

O. p. griseiceps: Sonora: 2 ♂, 1 ♀, Guirocoba; 1 ♂, 1 ♀, Los Algadones, 17 mi. NE San Bernardo.

O. vetula mccalli: San Luis Potosí: 2 ♂, Rancho Maitinez, 15 mi. S Naranjo; 1 ♂, 1 ♀, 16 mi. E Ciudad del Maíz; 1 ♂, 30 mi. E Ciudad del Maíz. Nuevo León: 1 ♂, 8 mi. NW Montemorelos; 1 ♂, 1 ♀, 15 mi. SW Linares. Tamaulipas: 1 ♀, Río Guayalejo, 20 mi. E El Mante; 1 ♂, 1 ♀, Rancho Acuña, 30 mi. N Gonzales; 1 ♀, Río Corona, 18 mi. N Ciudad Victoria; 1 ♀, Magiscatzín. Veracruz: 1 ♂, 1 ♀, Laguna Tamiahua; 2 ♂, 1 ♀, 17 mi. N Poza Rica.

O. v. vetula: Puebla: 1 ♂, 3 ♀, 30 mi. N Huauchinango. Veracruz: 2 ♂, 2 ♀, 20 mi. W Rodriguez Clara; 2 ♂, Arroyo Claro, 7 mi. E Loma Bonita in Oaxaca. Oaxaca: 1 ♂, Palomares; 1 ♀, Soyaltepec. Chiapas: 2 ♀, Palenque.

O. v. leucogastra: El Salvador, 2 ♂, 9 ♀.

THE STATUS OF O. POLIOCEPHALA AND O. WAGLERI

From a study of measurements of extremes and averages of the races of *O. vetula* and *O. wagleri* given in table 1 and taken from Ridgway and Friedmann (1946) it is evident that *O. poliocephala* can be separated from *vetula* on the basis of its greater size. In adult males there is no overlap at the extremes of the wing or tarsal measurements, but some overlap is observable in the lengths of tail and culmen. Nevertheless, these parts average considerably larger than in any of the races of *O. vetula*. In addition to the greater length of the tail, Ridgway and Friedmann (*loc. cit.*) point out that the tips of the rectrices are much broader in *poliocephala*, "45–60 mm.," while those of *O. v. mccalli* range from "15–20 mm." The tips of the rectrices of *O. wagleri* are listed as ranging from "35–50 mm." We cannot account for the disparity in the width of the tips of the rectrices between *wagleri* and *poliocephala* in Ridgway and Friedmann's figures, for we have many specimens of the former that equal or exceed the latter in this dimension. Neither can we wholly agree with Ridgway and Friedmann's diagnosis that *poliocephala* is similar to *vetula* except for size and coloration. The feathers of the foreneck and malar region of *poliocephala* are distinct; they are rigid and acuminate-lanceolate, a condition shared by *wagleri* but not seen by us in any of the races of *vetula* examined.

In addition to the morphologic dissimilarities just mentioned, Wagner (1953) points out that the two forms differ with respect to voice, breeding biology, and habitat requirements. Although the habitats overlap at various points on the Isthmus of Tehuantepec, no intergradation or hybridization is known.

Considering the foregoing evidence collectively, we can see no reason for the retention of *poliocephala* as a race of *O. vetula*.

Until recently it was believed that the ranges of *O. poliocephala* and *O. wagleri* were separated by most of the state of Jalisco; however, through the efforts of Allan R. Phillips in northwestern Jalisco, it has become evident that not only do *poliocephala* and *wagleri* meet but that they interbreed. We have examined a small sample of this intergrade population and feel that additional comment is warranted.

An adult female from Bahia de Banderas, Jalisco, designated as *wagleri*, shows an interesting combination of characters. The ventral coloration is much lighter than in typical *wagleri*, especially on the upper abdomen and yet it is darker than in *O. p. lajuelae*; the crest, although worn, is intermediate between that of *O. wagleri* and *O. poliocephala*; the central pair of rectrices is uniform except for the slight markings on the abraded tips; the next pair is clearly marked as in *poliocephala*.

An adult male and adult female from Carboneras, Jalisco, while representative of

lajuelae, are intergrades toward *wagleri*. The upper abdomen of the male is slightly darker and the lower abdomen, flanks, thighs, and crissum much darker than in typical *lajuelae*; the female falls within *lajuelae* in this respect; a small frontal crest is present in both specimens; the central pair of rectrices is uniform in the female and indistinctly marked in the male; both specimens exhibit more chestnut on the tips of the rectrices than does *lajuelae*.

Fig. 1. *Ortalis poliocephala* (specimens from the Moore Collection unless otherwise indicated), left to right: *O. p. wagleri*, El Molino, Sinaloa; *O. p. wagleri* x *lajuelae*, Bahía de Banderas, Jalisco (Amer. Mus. Nat. Hist. 471461); *O. p. lajuelae* x *wagleri*, Carboneras, N Puerto Vallarta (A. R. Phillips Coll. 3867); *O. p. lajuelae* (type), Lajuela, Colima; *O. p. poliocephala*, 5 mi. NE Apatzingán, Michoacán, and Ostuta River, 5 mi. W Tapanatepec, Oaxaca.

The variable nature of the intermediate specimens and the limited area of their occurrence in northwestern Jalisco indicates a sharp gradient and further suggests introgression, or allopatric hybridization (Mayr, Linsley, and Usinger, 1953). Miller (1949) contends that there is no clear-cut distinction between intergradation and hybridization, and the material examined tends to support this view.

On the basis of this intergradation and the similarities mentioned we can only conclude that these forms are conspecific. Since *Penelope poliocephala* Wagler, 1830 has priority over *Ortalida wagleri* G. R. Gray, 1867, the forms should stand as:

Ortalis poliocephala poliocephala (Wagler)
Ortalis poliocephala lajuelae Moore and Medina
Ortalis poliocephala wagleri (G. R. Gray)
Ortalis poliocephala griseiceps van Rossem.

The validity of *O. p. griseiceps* has been questioned in recent years; however, until more comparative material becomes available, it seems desirable to recognize this form.

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Laboratory of Zoology, Occidental College, Los Angeles, California, and *Museum of Vertebrate Zoology, Berkeley, California, February 1, 1957.*

BREEDING BIOLOGY OF THE CALIFORNIA GULL

By WILLIAM H. BEHLE and WAYNE A. GOATES

The California Gull (*Larus californicus*) has been studied from several standpoints in recent years, particularly in the Great Salt Lake region of Utah. The general natural history has been presented by Beck (1942) and Behle (1957). Special studies are those on food habits by Greenhalgh (1952), on migration by Woodbury, Behle and Sugden (1946), Behle and Woodbury (1952), and Woodbury and Knight (1951), on the plumage cycle by Behle and Selander (1953), and on the annual reproductive cycle by Johnston (1956*a*, 1956*b*). Despite all this effort, certain phases of the early breeding biology had still not received the detailed attention that they merited. Hence in the spring and summer of 1954 the writers undertook an intensive study to help fill in gaps in the knowledge of the species.

The study was made at Farmington Bay, a waterfowl refuge located on the east side of Great Salt Lake, 12 to 15 miles north of Salt Lake City. Here several artificially constructed islands are used each year by the gulls as nesting sites. One of these measuring about 90×312 feet was selected as the particular study site. The island was visited nearly every day by one or the other or both of us throughout the nesting season. The first hundred nests to be constructed made up the sample used for analysis. However, these constituted only about one-fourth of the nests that ultimately were present on the island. Numbered metal tags were used to mark the nests. They were attached to heavy gauge wire pushed a foot into the ground so that the gulls could not dislodge the markers. Later as the vegetation grew, numbered stakes were placed in the vicinity of the nests. As the eggs were laid in the nests, they were numbered with a soft wax pencil for identification. All the eggs were measured and a sample was weighed. The young were banded with regulation bands and were weighed at intervals; their total lengths were measured in inches, and temperatures were taken with a fast-recording mercury thermometer. The nesting events and the fate of the eggs and young were recorded.

EGG LAYING AND INCUBATION

Time of nesting and egg laying.—California Gulls begin to arrive from their wintering grounds on the Pacific coast in late February and early March. In 1954 they started nesting earlier than usual. At the time of our first visit to the island on April 9 we found seven nests with ten eggs. One nest contained 3 eggs and another 2 eggs, while the remaining 5 eggs were located in 5 different nests. Probably the first egg was laid about April 5. Our second visit to the island was made on April 11. At this time 28 nests contained 36 eggs distributed as follows: 2 nests had 3 eggs, 4 nests had 2 eggs, 22 nests had one egg. By April 16, our sample of 100 nests had all been constructed and marked. They contained from one to 3 eggs. On April 23, egg-laying for the 100 nests was completed. On this date 93 nests had three eggs each and 7 had 2 eggs each, making a total of 293 eggs laid in the 100 nests.

A summary of the egg laying is given in table 1. The number of nests with one egg showed a steady increase from April 9 until the 13th, with a steady rate of decrease after this date until April 22. The number of nests with two eggs showed a similar rate of increase and decrease with April 16 having the largest number, namely 47 nests containing two eggs. The number of nests containing three eggs built up slowly, showing the greatest increase after April 13. Such nests continued to increase until April 23 which date marked the completion of the laying in our sample of 100 nests. The peak of egg laying for the group occurred on April 13 when an increase of 52 eggs was noted in a 24-hour period. From the 13th to the 16th an increase of 63 eggs occurred, but this was

over a 41-hour period. Egg laying continued on the island until approximately May 20. This was a full month after the 100 study nests had been marked and egg deposition in them completed.

Interval between deposition of eggs.—Unfortunately our work schedule was such that we could not visit the island at the same time every day. The dates and times of

Table 1

Summary of Egg Laying

Date	Time of observation	Number of nests with 1 egg	Number of nests with 2 eggs	Number of nests with 3 eggs	Total number of nests with eggs	Total number of eggs	Egg increase
April 9	3:00 p.m.	5	1	1	7	10	....
April 11	9:00 a.m.	22	4	2	28	36	26
April 12	3:00 p.m.	25	14	3	42	62	26
April 13	3:00 p.m.	55	22	5	82	114	52
April 15	8:00 a.m.	43	34	22	99	177	63
April 16	3:00 p.m.	20	47	33	100	213	36
April 17	9:00 a.m.	11	38	51	100	240	27
April 20	3:00 p.m.	2	12	86	100	284	42
April 22	8:00 a.m.	....	8	92	100	292	8
April 23	3:00 p.m.	....	7	93	100	293	1

our visits during the egg-laying period are shown in table 1. Each time we visited the island the number of eggs was recorded for each nest. Our data enabled us to determine the interval of laying on this daily basis between the first and second eggs for 83 nests, between the second and third eggs for 50 nests and that between the first and third eggs for 46 nests. The results are presented in table 2. If there was a question as to the date on which the egg was laid, that is, whether one or two days were involved, these nests were placed in a separate category. From one nest to another, the interval between the first and second eggs varied from 1 to 4 days. Of the total of 83 nests, 75 or 90.4 per cent had an interval of either "1 to 2," 2 or "2 to 3" days. In contrast, there were only 2 nests with an interval of one day, one with 3 days, 3 with "3 or 4" days and 2 nests

Table 2

Summary of Intervals between Egg Deposition in Clutches

Interval between eggs	Between eggs 1 and 2		Between eggs 2 and 3		Between eggs 1 and 3	
	No. nests	Per cent	No. nests	Per cent	No. nests	Per cent
1 day	2	2.40	2	4	....	....
1 or 2 days	16	19.27	7	14	....	....
2 days	37	44.57	27	54	....	....
2 or 3 days	22	26.50	12	24	....	....
3 days	1	1.24	....	....	2	4.35
3 or 4 days	3	3.62	1	2	....	....
4 days	2	2.40	1	2	24	52.18
4 or 5 days	....	....	....	....	15	32.61
5 days	....	....	....	....	1	2.17
5 or 6 days	....	....	....	....	1	2.17
6 days	....	....	....	....	2	4.35
7 days	....	....	....	....	1	2.17
Totals	83	100	50	100	46	100

with an interval of 4 days. The majority of the nests had a two-day interval, since 37 or 44.57 per cent showed this situation.

With regard to the lapse of time between layings of the second and third eggs, it will be noted in table 2 that a larger percentage of the nests had an interval of two days than any other interval. Many of those included in the "1 or 2 days" and "2 or 3 days" categories may well have had two days between layings. Since the majority of birds had a two-day interval between the first and second eggs and also between the second and third eggs, it should follow that the normal interval between the first and third eggs would be four days. In substantiation of this we have the following data. Of the 46 nests for which the interval of egg deposition was definitely ascertained, 24 nests or 52.18 per cent had a 4-day interval and 15 nests or 32.61 per cent were in the 4- or 5-day category, thus making a total of 39 nests or 84.79 per cent that showed either 4, or 4 or 5 days between the laying of the first and third eggs. Probably most of the 15 eggs in the 4- or 5-day category were actually laid at a 4-day interval. Two nests of the 46 had a 3-day interval and 5 had five days or longer between the first and third egg.

Clutch size.—Since 93 of the 100 nests had 3 eggs each and only 7 had 2 eggs, it would seem that the normal clutch size is 3 eggs, at least for the gulls in this region. Observations on other nests on the same island not included in the study sample and on nests on other islands also indicated that three eggs constitute the normal clutch. Only one nest out of approximately four hundred observed on the study island had more than three eggs. It contained four and there was serious doubt that the fourth egg belonged there since its pattern of markings and coloration were quite different from the other three which were all like one another.

The seven nests that did not have the normal complement of three eggs may have several explanations. They may simply indicate differences between individuals in egg-laying characteristics. Or perhaps three eggs were indeed laid in these nests but something happened subsequently to one egg in each case; an egg may have been removed by either the rightful owner or an intruding gull. We found no evidence, however, that this had happened. Possibly the females attached to these seven nests dropped their third eggs in the water surrounding the island when disturbed by our approach. Yet another explanation may be that the owners of these nests actually laid three eggs but that one was laid in another nest. In addition to the instance previously mentioned of a nest containing four eggs, one of which had different markings and color, we found several instances on other islands of odd eggs in nests where there were but three eggs. Such situations seemed to occur with greater frequency among the late nesters. Unfortunately we did not follow through on these nests to see if they would ultimately contain a set of four eggs made up of a presumed full complement of three laid by the rightful owner in addition to the supposedly foreign egg.

Except for the fact that these seven nests were among the first 100 constructed, another possible explanation would be time of arrival. This was suggested by observations on another island. On April 17, when we were there we found but four nests with eggs, whereas on the study island at the same date the 100 marked nests already contained 240 eggs. On May 23 this other island was again visited and it was ascertained that of the approximately 150 nests then on the island, four-fifths contained only two eggs. A few contained one egg and the rest had three eggs. Subsequent visits revealed that a third egg was not added in most of the nests that had had two.

This particular island with numerous two-egg clutches seemed to be less desirable as a nesting site than most of the other islands. It was located close to the main cross dyke of the refuge and so was more subject to disturbance by passing patrol cars. Furthermore it was not completely surrounded by water. It seemed that the other more favor-

ably located islands on the refuge were chosen by the early nesters, leaving this less desirable island for the late nesters and possibly at the same time the late arrivals. Bearing on this supposition are the findings of Johnson (1956*a*:138) for the California Gulls at Mono Lake, California. On May 30, 1953, he ascertained that in the majority of nests the clutch size was two. The gulls nested later at Mono Lake in 1953 than did our study sample at Farmington Bay in 1954. An alternative explanation in this case is that there is an average difference in clutch size from one region to another.

In pursuing this subject further we conducted several experiments on seven nests that were not part of the 100 marked nests, duplicating the procedures that Davis (1942:553) worked out for the Herring Gull (*Larus argentatus*). In each case the California Gulls laid a total of three eggs regardless of how many eggs were placed in the nest or how many were taken away. These results indicate that this species as well as the Herring Gull is a determinate egg layer, but more investigation should be done on this phase of the breeding biology of the California Gull. Johnston's finding (1956*b*: 212) that breeding adult California Gulls have three brood patches supports the conclusion that three eggs constitute the normal clutch.

Egg weights and measurements.—All the eggs in the sample were measured in millimeters. The longest egg laid was 73.2, the shortest 60.3. The widest egg was 49.9 and the narrowest 42.8. No definite relationship between length or width could be determined. There was no indication that the longest eggs were also the widest or the narrow-

Table 3

Egg Weights in Grams

Nest no.	Egg weights 1st egg	2nd egg	3rd egg	Nest no.	Egg weights 1st egg	2nd egg	3rd egg
3	70	71.2	. .	76	76	77.3	71.4
7	72.5	72.4	74.5	77	78.5	78.4	70.9
8	71.2	71.6	....	82	72.7	73.8	64.9
11	79.4	71.3	79.3	84	69.4	77.8	69.2
15	76	78.2	74.2	86	65.2	65.6	63
22	65.8	71.2	69.1	89	64	69	62.4
29	80	76.7	77.3	90	76.7	73.5	76.3
44	71.8	74.3	71	91	70	69.2	65.2
46	76.4	75.4	69.4	93	77.3	78.2	....
48	79.4	79.4	76.1	94	71.2	71	70.6
60	71.6	70.3	66.2				

est. One item of possible significance is that the first two eggs were of essentially the same size whereas the third was slightly smaller. The averages for the three eggs were as follows: for the first egg, 66.5 by 46.7, for the second egg 66.7 by 46.7, and for the third egg 65.9 by 45.5. This size difference between the first two and the third egg in the clutch is corroborated by the weight data for fresh eggs in 21 nests. The average of the first egg laid was 73.1 grams, for the second egg 73.6 grams, but for the third egg 70.6 grams. This did not hold true in all cases, however, for there were some nests in which the third egg weighed as much as or more than the first or second egg. The average weight of the 60 eggs weighed was 72.7 grams. The heaviest egg weighed 80 grams, the lightest 62.4 grams. In the majority of nests the eggs were fairly uniform in weight but in a few instances differences of as much as 15 grams were found between eggs in the same clutch.

Incubation.—Considerable variation was found in the incubation period. Comparing the data for all the eggs, the longest periods of incubation recorded for the first, second

and third eggs were, respectively, 33, 31, and 26 days, while the shortest periods were 24, 22, and 21 days. The average incubation time for the first eggs was 26.7 days, for the second, 25 days and for the third, 23.6 days. Thus the incubation time of the third egg was less than that of the second which in turn was less than that of the first. Although the average situation seemed to be a two-day interval of deposition between the first and second eggs and between the second and third eggs, as previously noted, there was great variation in the intervals between hatching of the eggs within a clutch. While in the majority of cases the third egg is laid approximately two days after the second egg, it usually hatches within 24 to 36 hours after the first two eggs have hatched. Yet there are cases where three days intervened between the hatching of the second and third eggs and other instances where all three eggs hatched at about the same time.

This situation is probably tied in with the vagaries of heat application to the eggs. There is probably variation between adults in the time of commencement and the faithfulness of incubation. Just when continuous incubation by the adults starts was not ascertained. Incubation may be desultory until the full set of eggs is laid. Thus in those cases when all three eggs hatched at about the same time it may be that incubation did not begin until the third egg had been laid. From frequent changes in the position of the marks placed on the eggs to identify them, it was evident that there was considerable turning of eggs in the nest. We were not able to determine how or how often this was done. This may have been done haphazardly as a consequence of arranging the eggs to fit the brood patches, but more probably it was done at regular intervals.

Hatching and nesting success.—Hatching first began on May 4 when we found pipped eggs in two nests. The peak of the hatching period occurred on May 12 when an increase of 61 chicks in a 24-hour period was noted. All the eggs that hatched did so by May 19. Those eggs that were cracked one day would be pipped from one to two days later. Usually if the eggs were pipped upon one of our daily visits the chick would be fully hatched the next day. The length of time that it takes to emerge completely from the egg, as revealed by our observations at other nesting sites, varies greatly with individuals; it ranges from about half an hour at one extreme to several hours at the other. This seemed to be due primarily to the vigor of the movements of the chick but it may also have been correlated with the degree of thickness and hardness of the shell. Some California Gull eggs were found to be soft and thin and easily crushed while others were hard and thick.

Of the 293 eggs in the 100 nests, 254 or 86.7 per cent hatched. The fate of the other 39 eggs is as follows: nineteen simply disappeared soon after being laid. The only other birds seen on the island were two Canada Geese (*Branta canadensis*) and it is doubtful that they disturbed the eggs. Predaceous birds like crows and ravens are seldom seen on the refuge. Because of the surrounding water it is unlikely that any predaceous mammal or reptile visited the island. The site was not visited to our knowledge by other people. Only authorized personnel of the State Fish and Game Department were permitted on the refuge and they were aware of the study in progress. As a further precaution the study island was posted on both ends with "do-not-disturb" signs indicating that research was in progress. The conclusion is, therefore, that the disappearance of the 19 eggs must be attributed to the gulls themselves. They may have been destroyed by marauding gulls but we saw no broken shells that would indicate this. More likely they were moved by the females that laid them and were not detected by us among the many unmarked nests on the island. They may have been rolled away from the original sites or carried in the buccal cavity. Experimentation showed that the mouth of an adult California Gull is extensive enough to enable it to engulf one of its own eggs.

Ten eggs were inadvertently broken in the course of the study. Three of these which

were very soft shelled were punctured by us as we were marking them. Four were fresh eggs smashed by adults in precipitous flight from their nests. Three others containing well developed embryos were found crushed in the nest. As to the remaining ten eggs, after the hatching date was long overdue, they were opened and the contents were found to be liquid and rotten so they were evidently infertile or the embryo died early.

Actually, in the study, 13.3 per cent of the total complement of eggs did not hatch. However, discounting the 19 that disappeared and the 10 accidentally broken, only 10 eggs out of the 293 or 3.4 per cent failed to hatch because of what might be termed normal causes. In other words about 10 per cent of the total loss was probably abnormal. On this basis the hatching success would have been about 96.6 per cent. This figure is probably high, however, for had there been no disturbance of the colony a few of the 29 lost or broken eggs perhaps would have failed to develop.

EARLY GROWTH OF THE YOUNG

Our study of the development of the young was less successful than that on the eggs primarily because the young were inclined to leave their nests readily and by the time they weighed 500 grams they could scarcely be caught unless chased for many yards. We were particularly reluctant to disturb the colony for fear of increasing the incidence of juvenal mortality through attacks on the young by non-parental adults. We did nevertheless weigh a sample of 128 birds in the early developmental stages.

The average weight for newly hatched young was 50 grams, with extremes of 40 and 60 grams. Newly hatched chicks measured from 5 to 5¾ inches long. The chick that weighed 40 grams was 5¾ inches long while others weighing 50 grams were but 5½ inches long. Differences in weight of 15 to 20 grams were recorded for birds the same length. The weight of the young increased steadily, but the most rapid rise occurred after they weighed 300 to 350 grams. The average gain in weight was 22.5 grams per day. By the time the chicks had attained a length of 12 inches they weighed 500 grams or over and were about 21 days old. Our data do not go beyond this point.

TEMPERATURE REGULATION IN YOUNG

The birds whose temperatures were taken ranged from individuals removed from pipped eggs and those just hatched to young that were almost completely feathered. Readings of both air and cloacal temperatures were taken but no evaluation was made of the microclimate of the ground cover. Following Bartholomew and Dawson (1952), a linear measurement was employed as an indication of relative age. This was the length of the bird from bill tip to the end of the pygostyle as the bird lay in a prone, extended position. There is no perfect correlation between total length and age because of such variable factors as the amount of food and state of health of the young. However, the following is an approximate concordance based on some studies on another sample of young measured at frequent intervals from the time they emerged from the egg until they reached 12 inches in total length. Young in the size category of from 5–5⅞ inches ranged in age from just hatched to one day old, 6–6⅞ inches from 1 to 4½ days, 7–7⅞ inches from 3½ to 7 days, 8–8⅞ inches from 5½ to 9½ days, 9–9⅞ inches from 9½ to 12½ days, 10–10⅞ inches from 13 to 18½ days, 11–12 inches from 15 to 21¼ days old.

Some of our temperatures were obtained in 1954. Readings were made on four different occasions when there were considerable differences from time to time in air temperatures. On these occasions the body temperature of the young greatly exceeded the air temperature. While the air temperatures ranged through 25°C. (from 8° to 33°C.) the body temperatures of even the smallest birds varied only a little over 7°C. The data

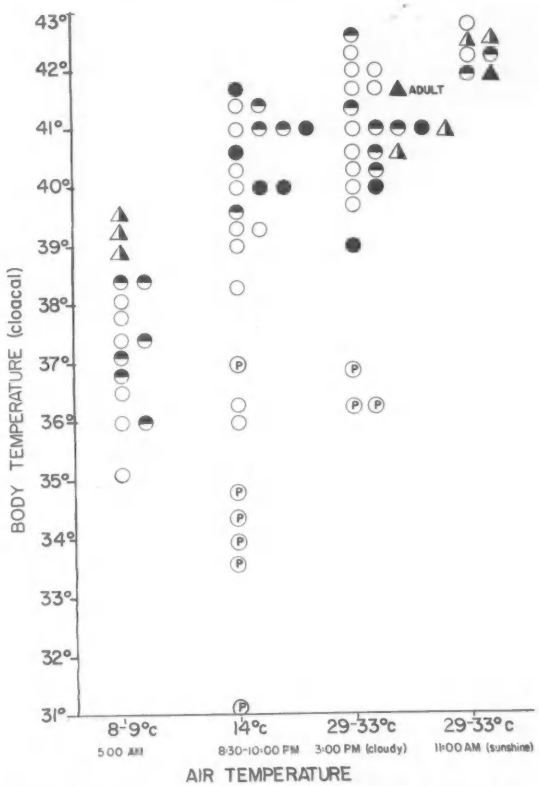

Fig. 1. Cloacal temperatures of nestling California Gulls plotted against air temperature; all in degrees centigrade. Symbols refer to age of birds as represented by body length in inches from tip of bill to end of pygostyle, as follows: circles with central P, birds removed from pipped shells; clear circles, 5 to 6⅞ inches; half-black circles, 7 to 8⅞ inches; black circles, 9 to 10⅞ inches; half-black triangles, 11 to 12⅞ inches; black triangles, over 13 inches, one of which was an adult.

for these samples suggest that up to an air temperature of 14°C. young gulls one or two days old are not able fully to regulate their body temperature. At environmental temperatures from 29° to 33°C. the temperatures of all sizes of young measured are more nearly the same. In other words at temperatures between 29° and 33°C. there was little difference in the body temperatures of newly hatched young and those of larger size. Hence somewhere between these temperatures the young show the ability to maintain their body temperatures when not brooded by the adults.

Realizing the inadequacy of these data special effort was made to gather data for a large sample of young on a relatively cold and constant day. The opportunity was presented on June 3, 1955, when the air temperature varied only from 10° to 11°C. over

a two-hour period, commencing at 9:30 a.m., which length of time it took to gather the data. The results for 1955 are presented in table 4 and corroborate the findings of the previous year. On this cold, misty day the young for the most part had taken shelter in the vegetation and were relatively inactive. Most, especially those of smaller sizes, were picked up without having to be chased. The amount of struggle put up varied with

Table 4

Cloacal Temperature Data for 118 Young California Gulls at Environmental Temperatures of 10° to 11°C.

Size-age group (Total length in inches)	Number of specimens	Temperature extremes	Range of variation
Pipped egg	8	17.5–28.4	10.9
5–5⅞	18	21.2–38.0	16.8
6–6⅞	32	26.6–39.0	12.4
7–7⅞	23	30.0–39.2	9.2
8–8⅞	17	26.8–39.2	12.4
9–9⅞	8	37.2–39.8	2.6
10–10⅞	4	38.6–40.0	1.4
11–12	16	39.4–41.0	1.6
Adult	1	40.0	.....

the individual, some being docile while others fought vigorously. Thus there were many variables. Of the hatched birds, the four smallest categories showed a wide range of cloacal temperatures, suggesting that at these developmental stages the temperature regulatory mechanism is poorly developed, especially in those smaller than 6 inches in length. In the 6–6⅞-inch group the temperatures are bunched near the upper limits. Our sample for the 9 to 9⅞-inch category was small but the individuals fall close together, suggesting that this is about the age of stabilization of the temperature regulatory mechanism. The last size-age category, from 11 to 12 inches in length, had the highest temperatures of all, ranging from 39.4° to 41°C. These are probably close to the temperature of the adults. We were able to get only one adult cloacal temperature of an injured bird; it was 40°C.

The results for the California Gull are similar to those obtained by Bartholomew and Dawson (1952) for the Western Gull (*Larus occidentalis*). They conclude that shortly after hatching the capacity to regulate temperature is sufficiently well developed that in air temperatures between 19° and 28°C. there is little difference in body temperature between newly hatched and fully feathered individuals whereas between 14° and 18°C. the small birds, despite huddling, have more labile body temperatures than do the larger birds.

Bartholomew and Dawson also suggested that Western Gulls have some ability to regulate body temperature before hatching. The basis for this was the data from two specimens removed from pipped eggs that had not been incubated for 45 minutes. The cloacal temperatures of these examples were 32.3° and 33.8°C. when the air temperature was 27°C. Radiant energy had been reduced by a low overcast and shelter from tussocks of grass. With respect to this situation in the California Gull, on the day when the air temperature was 10–11°C. we measured the cloacal temperatures of eight young removed from pipped eggs at the end of the two-hour period of taking temperatures of various sizes of young. The eggs had not been incubated for at least two hours. The cloacal temperatures of these young ranged from 17.5° to 28.4°C. While considerable individual variation was shown, all were substantially higher than the environmental

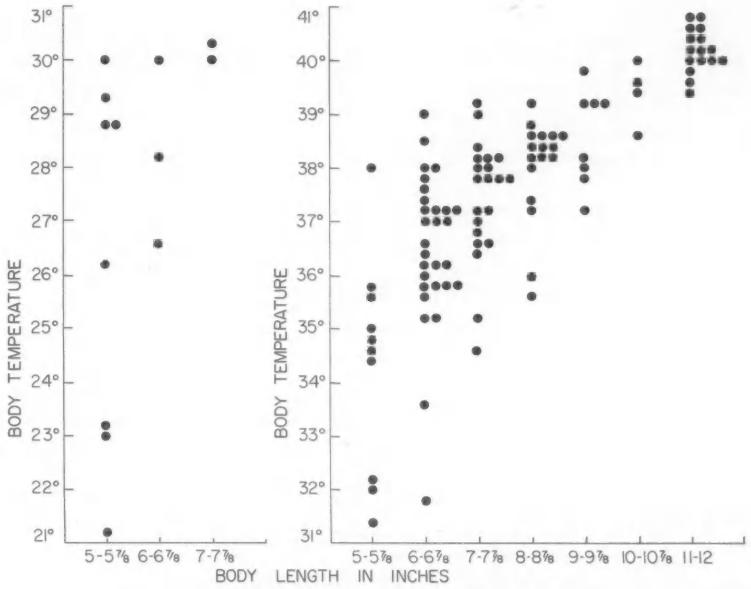

Fig. 2. Cloacal temperatures of nestling California Gulls in degrees centigrade taken when the air temperature ranged from 10° to 11°; age categories expressed in inches of total body length.

temperature. Three recorded as 17.5°, 19°, and 21°C. had temperatures lower than the lowest temperature of newly hatched young in the 5 to 5⅞-inch category. The other six ranged from 22.8° to 28.4°C., which places them in the lower limits of the widespread temperature range of the 5–5⅞-inch groups. The tendency to rapid heat loss in these unhatched birds when exposed is shown by successive readings for two individuals. One dropped from 21° to 19.2°C. in three minutes, the other from 28.4° to 27°C. in one minute. In addition to the relatively large surface area, they were moist and so did not have the dry, fluffy, downy feather covering that a normally hatching gull would have within an hour or so after emerging.

Despite the indication that a heat regulatory mechanism is present at an early stage, there is in young California Gulls heat loss or gain depending on environmental temperatures. If exposed to the direct rays of the sun for a few minutes the body temperature rises. In one experiment in 1954 a chick was exposed to the sun for 20 minutes and its temperature rose 2°C. Probably some young die as a result of this type of overexposure such as occurs when parents are careless in shading them or a disturbance causes the adults to leave their nests. During cold periods when young gulls are unable to supplement their metabolic heat through absorption of radiant energy, their body temperatures drop if there is prolonged exposure. For instance, the temperature of a day-old chick five inches long was taken at 5:00 a.m. when the air temperature was 8°C. After 40 minutes exposure its temperature was again taken. Whereas the air temperature had risen 1°C. that of the gull had dropped from 36° to 31.5°C. As a further indication of a gradually increasing temperature-regulating mechanism, other young a

few days older showed no such loss of body heat after the same length of exposure. In young gulls weighing 350 grams and having a length of 10½ inches, a temperature rise of about 3°C. was noted from night to day. In connection with the influence of the environmental temperature on the gulls' temperature regulating mechanism, mention should be made of two features of behavior. At night the young huddle together presumably in an attempt to conserve heat. During the heat of the day they seek shade in the weeds.

To summarize, the indications are that in the California Gull, a precocial bird, there is some ability on the part of the young as early as the pipped-egg stage to regulate body temperature, but the efficiency of the temperature regulating mechanism increases as they grow older. This may be correlated with the development of the juvenal plumage. A labile condition persists until they reach about 9 inches in total body length. After this the temperature range narrows down and it is probable that by the time the young gull is 12 inches long the cloacal temperature is the same as that of the adult.

JUVENAL MORTALITY

From the 254 eggs that hatched only 177 young finally fledged. The loss of 77 or 30.3 per cent of the young is accounted for as follows. Twenty-one were picked to death by adult gulls. At no time during the course of the study did we witness an egg being broken open or young being molested by adults, but we have observed both acts committed upon other occasions in other colonies. We deduced this to have been the cause of the death of this contingent of young on the basis of the bloody, injured heads and backs. It is difficult to say how much this mortality factor was accentuated by our disturbance of the colony. However, when we were stationed in a blind and the colony was undisturbed, we noted a tendency for young a few days old to leave their nest sites and seek shade in nearby vegetation. At the time of these movements the young were vulnerable to attack by adults other than their parents. Pettingill (1939:423) found this cause of mortality to be important for Arctic Terns (*Sterna paradisaea*) and notes that this form of infanticide is commonly observed in ground-nesting sea-bird colonies.

For the other 56 young found dead there was no obvious cause of death. They were found as a rule in or near the nests. Probably the mortality causes were varied and involved such factors as exposure to rain and cold or extreme heat, disease, and possibly desertion or even starvation. Probably most of this mortality was natural, although conceivably our presence may have been a contributing factor in some instances.

TOTAL MORTALITY AND NESTING SUCCESS

The total mortality from loss of both eggs and young up to the time the young learned to fly and left the island was 116 or 39.5 per cent of the potential number of new gulls (293). Thus the reproductive success was 60.5 per cent.

What percentage of those young gulls that fledged would successfully pass through the juvenal stage and succeeding years until old enough to reproduce is, of course, not known, but the mortality probably continues to be high. Woodbury and Knight (1951: 72) analyzed the data pertaining to returns for bands taken from dead juvenal gulls and showed that the peak of mortality for the California Gulls after the exodus from the nesting areas was in late summer and early fall. A secondary peak extending from November to January also shows on their graph. We have had no returns from the 177 banded gulls that survived the island-rearing period.

Taking into consideration the actual losses in both eggs and young, the following data bear on the success of individual nests. Of the 93 nests that contained 3 eggs at the beginning of the incubation period, only 65 or 69.8 per cent had all eggs hatch. Of

these nests that had 100 per cent hatching success, 22 nests fledged 3 chicks, 29 others fledged 2 young each, 11 fledged one young each and 3 nests were in the end entirely unsuccessful in that all 3 chicks died. Twenty-three nests of the 93 that originally contained 3 eggs hatched 2 eggs. Of these, 12 resulted in 2 fledglings, 9 fledged only one chick each and 2 nests had losses of both their chicks. No instances were observed where only one of the original complement of three eggs hatched, but in five nests not even one of the eggs hatched. Thus from these 93 nests with a full complement of 3 eggs each, 168 fledged chicks resulted. This is a 60.2 per cent reproductive success.

As to the 7 nests with a full complement of 2 eggs each, 3 hatched both eggs and all the chicks lived. Two hatched both eggs but in each case only one chick lived. One hatched only one egg and this resulted in a fledgling. In the last nest of the two-egg category only one egg hatched and the young died. Thus from the 7 two-egg nests, 9 chicks fledged representing a 64.2 per cent reproductive success. Thus a slightly better percentage of reproductive success came from the nests with two eggs. The latter sample was, however, small, and the difference is not significant.

SUMMARY

In the spring of 1954 a study was made of certain aspects of the breeding biology of the California Gull (*Larus californicus*) in a sample of 100 nests at the Farmington Bay Refuge on the east side of Great Salt Lake, Utah. The egg laying commenced about April 5 and was finished on April 23 for the sample, with the peak of egg laying occurring on April 13 when an increase of 52 eggs was noted in a 24-hour period. However, deposition of eggs continued on the island, in other nests which were not part of the sample, until May 20. Ninety-three of the 100 nests finally came to contain 3 eggs each and 7 two eggs each for a total of 293 eggs.

Evidence is presented to show that the species is a determinate egg layer.

The interval between the laying of the first and second eggs varied among nests from 1 to 4 days but in the majority of cases it was 2 days. Likewise the interval between the second and third eggs was in most instances two days.

The average measurements for the first eggs of the sets were 66.5×46.7 mm., for the second egg 66.7×46.7 and for the third egg 65.9×45.5. Sixty eggs had an average weight of 72.7 grams. The first-laid eggs average 73.1 grams, the second eggs, 73.6, and the third eggs, 70.6.

The average incubation time for the first egg was 26.7 days, for the second, 25, and for the third, 23.6. In the majority of nests it was judged that incubation began after the second egg was laid. Hatching began on May 4. The peak occurred on May 12, and all in the sample were hatched by May 19. The eggs that hatched numbered 254 or 86.7 per cent.

The average weight for newly hatched young was 50 grams and such young measured about 5½ inches in length. The average gain in weight was 22.5 grams per day. By the time the chicks had attained a length of 12 inches they weighed 500 grams or more and were about 20 days old.

There is evidence that young one or two days old have some ability to regulate body temperatures; thereafter the efficiency of the temperature regulatory mechanism increases. A labile condition persists until the young reach about 9 inches in total body length; by the time the young gulls are 12 inches long the cloacal temperatures are fairly stable.

There was a loss of 77 or 30.3 per cent of the young. The total mortality among both eggs and young was 116 or 39.5 per cent. Reproduction success was thus 60.5 per cent.

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Department of Zoology, University of Utah, Salt Lake City, Utah, February 15, 1957.

NOTES ON BIRDS OF THE PROVINCE OF BOCAS DEL TORO, PANAMA

By EUGENE EISENMANN

The province of Bocas del Toro occupies the northwestern part of the Caribbean slope of Panamá, adjacent to Costa Rica. Special avifaunal interest attaches to this area because here a number of wide-ranging Middle American species and strongly characterized subspecies reach their southern limit. In several instances these Central American forms meet, or almost meet, their South American geographical representatives, which have invaded the Isthmus of Panamá from the opposite direction. Deforestation on the coastal plain, by facilitating range extension of clearing and "edge" birds, is increasingly promoting contacts between closely allied forms formerly separated by heavy forest. The interrelations of these morphologically different Central and South American representatives present questions of taxonomy, speciation, and ecology that would repay concentrated field study.

The Caribbean coastal plain in Bocas del Toro is narrow, being deeply indented by a large irregular embayment, the Chiriquí Lagoon, the western section of which, Almirante Bay, is almost enclosed by wooded islands. The continental divide, only thirty miles away, forms the southern limit of the province, and between this Talamanca range and the coast are a series of lower ridges. Across the divide, to the south, is the better known Pacific slope province of Chiriquí, including the Volcán de Chiriquí, the 11,000-foot summit of which can often be seen from the Caribbean coast. Most of the level country in the Almirante Bay sector was cleared a half century or more ago for banana cultivation. The currently used plantations have service roads and banana railways, which extend northwestward across the international boundary into Costa Rica and provide easy access.

No ornithological activity has been reported from the province of Bocas del Toro for the past quarter of a century, although the Almirante Bay region can be reached from Panamá city or from Chiriquí by regularly scheduled airplanes. In 1931 Peters published a list of 316 species, summarizing what was then known of the avifauna of the province, based chiefly on a collection of over a thousand skins made by H. Wedel between 1926 and 1929. Peters' list also included data available to him from other collections, notably one made by Kennard in the mountains (Kennard and Peters, 1928), and another from the coastal plain by R. R. Benson, partly reported by Griscom (1928) and Chapman (1931). Since Peters' 1931 paper, little has been published regarding the avifauna of the area. Griscom (1933) recorded an additional ten species from Bocas del Toro, in the Havemeyer collection, taken in 1927 by A. P. Smith. Hellmayr and Conover (1942:306) mention a specimen of the Limpkin (*Aramus guarauna dolosus*), and Zimmer (1955) identified an immature Purple Martin (*Progne subis hesperia*), collected by Benson on October 27, 1927. It was in the Almirante area, as a research botanist, in 1928–1929, that Skutch's interest in tropical birds was aroused (1954:7), with such fruitful results for Middle American ornithology.

Most of the reported collections have come from the vicinity of the plantations in the western sector near Costa Rica. As is to be expected, the bird-life of this Caribbean area more closely resembles that of adjacent southeastern Costa Rica than that of the Canal Zone farther east or of the neighboring province of Chiriquí on the Pacific slope across the continental divide. Yet a number of forms said to be regular in adjacent Costa Rica are still to be reported from Bocas del Toro. Some of these unquestionably occur, for Carriker in his Costa Rican monograph (1910) lists a half-dozen such forms as collected by him on the Río Sicsola (now usually spelled "Sixaola"), a river marking the present boundary between Panamá and Costa Rica. Carriker has written me that most of his

specimens designated "Río Sicsola" were taken on what is now the Panamá (Bocas del Toro) side of the river, and that this was certainly true of some specimens of the hummingbird *Chalybura melanorrhoa* and of the antbirds *Dysithamnus striaticeps* and *Gymnocichla chiroleuca nudiceps*, which have not been definitely recorded from any Panamanian locality; the hummingbird has been doubtfully reported (Griscom, 1933: 301). It is of interest that at Almirante, some twenty-five miles southeast of the Sixaola, this hummingbird and *Dysithamnus* are represented by closely allied South American forms (*Chalybura urochrysia isaurae* and *Dysithamnus puncticeps puncticeps*).

How much remains to be done before we have even an adequate inventory of the birds is indicated by the fact that on a five-day trip, visiting only a few of the most accessible localities, I observed thirteen species hitherto unreported from Bocas del Toro, one of which was wholly new to the Republic of Panamá—the White-collared Seedeater (*Sporophila torqueola morelleti*).

LOCALITIES VISITED

Through the courtesy of Mr. William Mais of the Chiriquí Land Company (Panamanian subsidiary of the United Fruit Company), I had the opportunity of visiting the plantations in the Almirante Bay area in 1956. On June 29 an airplane flight from Panamá City took me to the village of Bocas del Toro, situated on the tip of the Isla de Colón, one of the islands enclosing Almirante Bay. From there I went by launch across the island-studded bay to the mainland town of Almirante, administrative headquarters and port for the plantations of the area. Almirante is connected with the plantations by a network of railways. The district manager, Mr. Munch, and the assistant manager, Mr. Kidd, provided me with comfortable quarters at the company guest-houses at Almirante and Changuinola. Changuinola, where most of my sojourn was passed, is about eighteen miles northwest of Almirante by banana railway, only eight miles from Costa Rica, and about five miles from the Caribbean Sea. The guest-house was in a residential compound, on one side bordered by fruit trees (chiefly citrus), and on the other side overlooking a golf course with a fine vista of mountain ranges to the west and south. Changuinola is the present center of the banana growing area. While Changuinola is only a few feet above sea level, I found the climate pleasant, with the warm days tempered by cooling breezes from the mountains and the temperatures falling to 68°–70°F. at night. The annual rainfall of about 100 inches is well distributed, so that even the driest months (February and March) usually show at least four inches. During my five days stay, although there was a slight drizzle almost every afternoon, the heavy rain came only at night.

Most of the flat country about Changuinola was cleared for bananas by 1900, but before the end of the 1920's the "Panama disease" (*Fusarium cubense*) forced discontinuance of banana cultivation. Banana growing has now been resumed. The blight is kept under control by growing the bananas in large diked impoundments, which are artificially flooded periodically to deprive the soil fungus of oxygen. These impoundments, known locally as "lakes," are flooded in rotation and provide water birds with excellent habitats. The elevated dikes surrounding the impoundments facilitate observation, and their sloping sides, overgrown with aquatic vegetation and rank grass, are favored by rails and other marsh and grass birds. Mr. Peter Hogaboom, who guided me around, is a sportsman with previous experience in the United States and Honduras; he told me that migrant waterfowl were abundant on the "lakes" from November to April. Most common were American Coot (*Fulica americana*), Blue-winged Teal (*Anas discors*) and Lesser Scaup (*Aythya affinis*). Baldplate (*Mareca americana*) and Pintail (*Anas acuta*) often occurred in numbers, and he had also taken the Northern Shoveller

(*Spatula clypeata*). While there is no published record from Bocas del Toro for the last three species, specimens are known from even farther southeast in central Panamá.

On June 30 I briefly visited one of the flooded "lakes." Breeding grebes, gallinules and jacanas were plentiful, and two species of rail were repeatedly flushed. The same day we passed an hour in one of the remnants of original rain forest. July 1 and 2 were spent about the residential area of Changuinola and the neighboring roadsides and banana plantations. On July 3 Mr. Hogaboom took me by outboard motor down the San San River, two miles west of Changuinola, to its mouth on the Caribbean Sea. This is a beautiful tropical river, with slow, dark water overhung by swamp forest, and with beds of lavender water hyacinth growing profusely in the quiet shallows. The river becomes brackish and mangroves appear near its mouth, which at low tide is sometimes closed by a sand bar. On the afternoon of July 3 I returned by railway to Almirante, where I made a few observations in the residential area and the waterfront. On July 4 the launch took me to Bocas del Toro village. Pending the arrival of my airplane I spent a couple of hours in the open scrubby second growth immediately back of the town.

To facilitate orientation in the discussion, it is well to remember that the North American continent makes a sharp bend from west to east at the Isthmus of Panamá, so that western Panamá is the part connecting with North America, eastern Panamá connects with South America, the Atlantic Ocean (Caribbean Sea) is north of Panamá, and the Pacific Ocean is to the south, hence the old name "South Sea."

In the following list an asterisk marks species not previously reported from Bocas del Toro province. English names are from my "Species of Middle American Birds" (1955*a*).

Podiceps dominicus. Least Grebe. At least fifty noted on the flooded impoundment on June 30. One adult was followed by six young, and many larger immature birds were seen. Grebes are much more widely distributed in Panamá than was realized at the time of Griscom's check-list (1935). I have found this species breeding in June and July on the Volcán Lakes of Chiriquí, across the continental divide from Bocas del Toro, as well as on the Chagres River in the Canal Zone.

Podilymbus podiceps. Pied-billed Grebe. I made a quick count of ten on the flooded impoundment, some in breeding dress and others in juvenal plumage. Specimens from this area were attributed by Peters (1931) to the northern race *podiceps* and regarded as migrants. I have found this species with young in the same Panamanian localities as the Least Grebe during June and July. Van Tyne has assigned (1937) the breeding birds of the Canal Zone to the South American *P. p. antarcticus*. To determine the race to which the resident population of western Panamá belongs will require collecting in the nesting season.

Pelecanus occidentalis. Brown Pelican. A number noted in Almirante Bay and three at the mouth of the San San River.

Sula leucogaster. Brown Booby. Six (apparently the Atlantic form *leucogaster*) observed at close range in Almirante Bay, on June 29, a day during which there had been a severe storm.

Phalacrocorax olivaceus. Olivaceous Cormorant. Approximately thirty on the flooded impoundment.

Anhinga anhinga. Anhinga. One, perhaps two, on the flooded impoundment.

Fregata magnificens. Magnificent Frigate-bird. A number over Almirante Bay; some close to shore at Almirante, Bocas del Toro village, and the mouth of the San San. An English employee of the Chiriquí Land Company told me that on the previous day, July 2, while cleaning fish on the beach at the mouth of the San San River, he noticed a frigate-bird close by, swooping over the surf to pick up discarded floating pieces of fish. He then purposely threw a piece on the beach and was interested to see the bird swoop it up in flight, without making even a mark on the sand with its bill.

**Coragyps atratus*. Black Vulture. Very common in all localities visited. The absence of previous published records for Bocas del Toro doubtless reflects only the reluctance of collectors to prepare vulture specimens. At Almirante these vultures roosted at night in the coconut palms.

**Cathartes aura*. Turkey Vulture. Surprisingly uncommon. Only a few were noted at Changuinola and over the San San River, and one was seen at Bocas del Toro village.

**Heterospizias meridionalis*. Savanna Hawk. A juvenile studied on the dike of an impoundment near Changuinola on June 30. The bird, characteristically unwary, allowed approach to within about twenty feet before flying with slow beats of its long wings to another low perch a short distance off. This South American species is fairly common in the damp grasslands of the Pacific slope of Panamá. Although reported by Griscom (1935) only from western Panamá, it now regularly occurs in suitable localities east of Panamá city, favoring the green rice-fields. It has not been reported from the Caribbean slope of Panamá, which under natural conditions was forested; but its appearance in the extensively cleared areas of Bocas del Toro is not surprising. The presence of this hawk so near the Costa Rican border lends support to Zeledon's listing of this species from that country (1887:126), an occurrence rejected by later writers as unconfirmed (Hellmayr and Conover, 1949:83; Friedmann, 1950:209).

Buteo magnirostris. Roadside Hawk. Probably the Panamanian hawk most frequently noted in edge situations and fairly open country; observed at Changuinola, Almirante and Bocas del Toro. The bird at Changuinola was discovered while perched on a large banana plant by a pair of Clay-colored Robins (*Turdus grayi*), which noisily complained until a Great Kiskadee (*Pitangus sulphuratus*) drove the hawk away. The individual at Bocas del Toro was being chased by a Tropical Kingbird (*Tyrannus melancholicus*)—behavior I have seen repeatedly elsewhere in Panamá. Although this small raptor appears to feed chiefly on lizards, passerines seem to treat it as a menace. The English name here used, introduced by Sutton (1951:100), and since adopted by others, appears superior to any available in the literature. The species is, of course, not limited to roadsides (the Almirante bird was perched on a mangrove), but in tropical Middle America no other hawk is as frequently seen along the roadside, for it is a strikingly unsuspicious "edge" species.

Herpetotheres cachinnans. Laughing Falcon. One perched on a tree along the San San River.

**Porzana flaviventer*. Yellow-breasted Crake. Among the rails flushed from the grassy slopes of the dike bordering the flooded impoundment near Changuinola, on June 30, was this diminutive species. Two individuals afforded excellent views, showing buffy brown color, conspicuously white-streaked back, and dangling yellow legs. Before my trip I had examined specimens of this little-known species, because Dr. Alexander Wetmore had advised me of his discovery of this rail in Panamá in 1955 on the Chagres River, Canal Zone, and in 1956 near the Pacific coast in eastern Chiriquí. Although this species is widely distributed in South America and the Greater Antilles, the only Middle American locality definitely mentioned in the literature is Lake Olomega, El Salvador, from which van Rossem described the subspecies *woodi* (1934:243). Nicaragua was included in the range given in my Middle American list (1955*a*:27) on the basis of a specimen in the American Museum of Natural History, taken at San Francisco, San Juan River, May 22, 1917, marked "ovaries slightly enlarged." This little crake is probably widespread in fresh-water marshes.

Laterallus albigularis. White-throated Crake. On the same dike where the Yellow-breasted Crake was seen a number of these rails were flushed. Compared with *Porzana flaviventer*, they were larger and dark-backed, with mainly rufous head and neck, conspicuously black and white barred flanks, and dusky legs. This species does not require a wet marsh, for on July 1 two flushed from the grass of a dike bordering a dry impoundment in which banana plants were growing. One of these birds was a blackish juvenile that was flushed from a dry grassy spot where seedeaters (*Sporophila*) and Blue-black Grassquits (*Volatinia jacarina*) abounded.

Gallinula chloropus. Common Gallinule. At least ten, both adults and juveniles, were swimming in the flooded impoundment on June 30.

Porphyrula martinica. Purple Gallinule. Seen among the water hyacinths of the San San River and in a ditch bordering an impoundment. The Purple Gallinule has a wider distribution in Panamá than *Gallinula*, for it accepts habitats with little open water, provided there is a thick growth of aquatic vegetation. It often perches on top of marsh plants and shrubs and swims less than *Gallinula*.

Jacana spinosa. Middle American Jacana. The nominate race *J. s. spinosa* has "western Panamá" as its revised type locality (Ridgway, 1919:11). It abounds in shallow fresh-water areas about Changuinola and among the water hyacinths of the San San River. In my brief examination of one flooded impoundment I saw at least fifty, including many immatures. On June 30 in a small pool three partly-

grown young followed an adult. Only the male is known to incubate and care for the young (Miller, 1931:32–33; Dickey and van Rossem, 1938:167).

Most authors since Peters (1934:229) have treated all the American jacanas as one species. The situation in Panamá seems incompatible with this view, for the Middle American and South American forms there overlap, while maintaining their distinctive characters. The treatment of Wetmore (1939: 191) and de Schauensee (1949:434) seems preferable in recognizing the South American *J. jacana* as specifically distinct from the Middle American *J. spinosa*. Each of these has its own array of subspecies. The *jacana* group ranges through South America and north through most of Panamá; the *spinosa* group ranges through the West Indies and Middle America and south into western Panamá on both coasts, overlapping *J. jacana hypomelaena*, at least on the Pacific slope. The morphologically distinguishing characters of the two complexes are in the soft parts, which are strikingly different in life, but look deceptively alike when dry, shrunken and brown in museum skins. The *jacana* group throughout its range has well-developed rictal wattles and a fleshy excrescence over the bill, which forms a two-lobed frontal shield; wattles, shield and base of the bill are red to purplish-red. The *spinosa* group lacks wattles, and the fleshy frontal shield is differently shaped, being three-lobed; the shield and entire bill are bright yellow to orange-yellow, sometimes with a pallid bluish band and a narrow red bar at the base. These distinctive features are shared by adults of both sexes and are independent of plumage color. In both species complexes the body plumage is chestnut to maroon, except in the Panamanian race *J. j. hypomelaena,* which is normally all black. This race, which extends also over northern Colombia, produces throughout its range occasional maroon-backed birds that cannot be distinguished from the adjacent South American race *melanopygia* (Hellmayr and Conover, 1948:6; Todd and Carriker, 1922:188–189; Ridgway, 1919:5). The fact that the Panamanian race is the only race of *J. jacana* that differs strikingly in plumage from the chestnut-backed *J. spinosa* suggests that its distinctive black color serves as a reproductive isolating mechanism in the only area where the two complexes overlap and where an isolating mechanism is needed. Long ago Griscom (1935:305) reported that *spinosa* and *hypomelaena* were to be found in 1924 in the same pool near Remedios, eastern Chiriquí, "without producing intermediates." In 1954 and 1956 Wetmore collected in the same area and the adjacent part of Veraguas province, immediately to the east. Over a zone of about fifty miles from Zapotillo, Veraguas, to Las Lajas, Chiriquí, Wetmore found both forms, without noting intermediates. In fact he has shown me a kodachrome of two freshly killed birds taken in the same pool in western Veraguas in 1954, one a typical *spinosa,* the other a typical black *hypomelaena.* Hellmayr (in Hellmayr and Conover, 1948:5) states that a series from central Veraguas in the British Museum, collected almost a century ago, "shows complete intergradation between *hypomelaena* and *spinosa*," some birds being *hypomelaena,* and others variously intermediate. Hellmayr also suggests that Griscom may have been wrong in saying that true *spinosa* occurred at Remedios. I have compared the three Griscom specimens in the American Museum taken at that locality with birds from Costa Rica and northward. All three in their trifid frontal shield, absence of wattles, and chestnut plumage are *spinosa,* although one has the underparts a darker maroon than Costa Rican specimens, possibly indicating some *hypomelaena* blood. It is not unlikely that occasional interbreeding may occur. But that would not establish conspecificity. The test in the case of overlapping forms is whether interbreeding is so free and genic disharmony so absent that the two forms tend to merge and to lose their distinctive characters as a result of the contact. Here the evidence indicates the contrary. *J. spinosa spinosa* and *J. jacana hypomelaena* maintain the same characters in Panamá that they respectively show in Costa Rica and Colombia. Even in the zone of overlap there is little evidence of interbreeding. Presumably some factor operates unfavorably to the production or the survival of hybrids. Hence natural selection should promote the development of effective reproductive isolating mechanisms and strengthen those already existing (Huxley, 1943:68, 359–360; Dobzhansky, 1951:207–211). Applying the criteria of modern biologists, the co-existence of two forms in the same area, without tendency to merge, justifies their treatment as species, even though occasional hybrids may occur (Huxley, 1943:165; Mayr, Linsley and Usinger, 1953:101–103). The nomenclature adopted in an incompletely studied situation is a matter of more than technical convenience. When the same binomial is used, with interbreeding characterized as intergradation between subspecies, the over-simplification discourages further investigation. On the other hand, "hybridization" between species suggests a dynamic and unresolved situation, stimulative of additional field work.

**Charadrius collaris*. Collared Plover. Two pairs were feeding on the sand-bar at the mouth of the San San River on July 3. They had pink or flesh-colored legs and called a rather weak *peet-peet*. Although this species has not been previously reported from Bocas del Toro, Carriker (1910) took it on the Sixaola River.

Catoptrophorus semipalmatus. Willet. One on sand bar at the mouth of the San San River on July 3. Like many other shorebirds, non-breeding Willets can be found on coastal mud-flats in Panamá throughout the year, particularly on the Pacific side (Eisenmann, 1951, 1955*a*).

**Larus pipixcan*. Franklin Gull. One hooded adult or sub-adult flying at close range over Almirante Bay on June 29; white wing bands across the primaries were easily noted. Non-breeders are regularly present in Panamá during the summer.

**Chlidonias niger*. Black Tern. At least fifty seen in Almirante Bay on July 4 (fewer on June 29), in small loose groups ranging up to twenty, from near Almirante to Bocas del Toro. None in breeding plumage. A common non-breeder in Panamá during the summer, most numerous on the Pacific coast, but also on the artificial fresh-water lakes of the Canal, as is true of the other larids here mentioned.

**Sterna hirundo*. Common Tern. Six in Almirante Bay on June 29. Another species commonly and regularly summering as a non-breeder in Panamá.

**Thalasseus maximus*. Royal Tern. One in Almirante Bay on July 4; orange bill and other characters observed. A regular summer non-breeder in Panamá.

Columba cayennensis. Pale-vented Pigeon. The common large pigeon about Changuinola, usually flying over in pairs or small groups, but sometimes perched; also on the San San River. At Almirante one was on the bare top of a tree growing over mangroves, calling *rúk-too-coooo*. This species favors semi-open second growth, avoiding heavy forest. Where not persecuted, it will even nest in suburban gardens, but being hunted constantly in Panamá, it has become quite wary in most localities.

Columba speciosa. Scaled Pigeon. In the remnants of rain forest near Changuinola I heard the characteristic *ptoo* of this usually solitary pigeon coming from the top of a tall dead tree.

Columbigallina talpacoti. Ruddy Ground Dove. Abundant everywhere about roads, gardens, and open places in Changuinola, Almirante, and Bocas del Toro.

Geotrygon montana. Ruddy Quail-Dove. In the undergrowth of the rain forest near Changuinola I heard the characteristic humming moan of this species.

Aratinga finschi. Crimson-fronted Parakeet. Noted regularly in the late afternoons at Changuinola, at least ten pairs coming in to roost in the coconut palms and certain heavily-foliaged tall trees near the residential area. They attracted attention by their noisy calls but were hard to see once they settled in the trees. At Almirante on July 3, between 5 and 6 p.m., at least a hundred pairs flew in to the coconut palms planted about the dwellings on the waterfront. From two to four pairs roosted in each palm tree, at the base of the fronds. On first arriving the birds called loudly, a harsh, guttural note, with a mellow undertone, *keerr-keerr*, sometimes more elaborately *kewkeekeekeekee kewkeerr*. By dusk they were quiet. At about 6:10 a.m., when it had become light again, they started to call, and pairs began to fly from one palm to another as if "visiting." About 6:30 a.m. they commenced to leave their roosts in flocks of about thirty to fifty birds, all flying roughly eastward toward wooded country.

Amazona farinosa. Mealy Parrot. A pair perched in a tree of the forest along the San San River on July 3.

Pionus menstruus. Blue-headed Parrot. Four parrots with the deep wing stroke of this genus and calling like this species were seen flying over the forest near Changuinola on June 30 and also across the San San River on July 3. Conceivably they might have been *Pionus senilis*, which has also been recorded from this region (and with which I am not familiar), but Peter Hogaboom said that although he had often observed Blue-headed Parrots in the area, he had never seen a White-crowned one (*P. senilis*).

Piaya cayana. Squirrel Cuckoo. One in a tree at the edge of the San San River on July 3.

Crotophaga sulcirostris. Groove-billed Ani. Abundant on lawns and roadsides and in gardens and other grassy places about Changuinola, Almirante, and Bocas del Toro village. Although a familiar bird in many parts of the Pacific slope of Panamá, nowhere have I found it so common or tame as on the Changuinola golf course. Here it seemed to occupy a niche that on the lawns of the Canal Zone is occupied by the Boat-tailed Grackle (*Cassidix mexicanus peruvianus*)—a species unrecorded in this

region or Caribbean Costa Rica (Carriker, 1910). I saw a Kiskadee (*Pitangus sulphuratus*) drive off one of these anis, which was sitting quietly on the golf course fence.

The distribution in Panamá of this species and its ally the Smooth-billed Ani (*Crotophaga ani*) shows the apparently conflicting effects of ecological and geographical factors. Both these anis are birds of grassy areas, and both occur in the open parts of the Pacific slope of Panamá. About the city of Panamá I have sometimes seen groups of the two species in the same field, although not actually associating. West of the Canal Zone the Groove-billed Ani is the species of this genus usually found in the drier scrubby areas that prevail in Coclé province and westward to Chiriquí province. In the more humid and richer pastures of the formerly forested parts of western Chiriquí, and up into the mountain clearings there, at least to 4200 feet, I have seen only the Smooth-billed Ani. This distribution suggests that in Panamá *C. ani* favors the damper areas and *C. sulcirostris* the drier grasslands. This preference seems to be confirmed by the situation in the Canal Zone, where only *C. ani* is known in the forest clearings of the humid Caribbean slope, including such small ones as occur on Barro Colorado Island. Yet in Bocas del Toro, one of the most humid areas of the Caribbean slope, not *C. ani* but only *C. sulcirostris* is known. The explanation appears to be geographical. Bocas del Toro was forested until the nineteenth century and probably lacked ani habitats. When extensive banana clearings were made, they were much nearer those of Costa Rica than those of central Panamá, so the new habitat was colonized from Costa Rica, where only the Groove-billed Ani occurred (Carriker, 1910). The Groove-billed is the ani of Middle America; the Smooth-billed is essentially a South American species. Curiously enough, the same type of banana clearing that made possible the invasion of the Groove-billed Ani into Caribbean Panamá from Costa Rica has recently facilitated the invasion of the Smooth-billed Ani into the Pacific slope of Costa Rica from Panamá. The first published record of *C. ani* from Costa Rica was from the Pacific banana district of Río Coto (formerly forested) near Chiriquí (Bent, 1940:25). Skutch has now reported the appearance of this ani farther northwest, in country where *C. sulcirostris* is still dominant. Whether the Smooth-billed Ani will now extend northward will be interesting to watch.

Distinguishing these two anis in the field is not difficult. However, the presence or absence of bill grooves is usually hard to determine. A more conspicuous bill character is the unbroken arc of the culmen in the Groove-billed Ani, while the Smooth-billed shows at the base of the culmen, in profile, a thin irregular projection that breaks the smooth arc. The Groove-billed is a smaller and sleeker bird. The best field character is the voice. In addition to various guttural clucks, the Groove-billed Ani gives a short rather dry *swilk* or *hwilk*, usually uttered in a series, *hwilk, hwilk, hwilk, hwilk*, and sometimes accelerated so as to suggest the *wicka-wicka-wicka-wicka* of a flicker (*Colaptes*), or it may sound like *suck-suck-suck-suck* or *sick-sick-sick-sick*. The corresponding call of the Smooth-billed Ani is a whining, long-drawn *ooeeeék* or *oooo-eeeelk*, which may be repeated several times.

Streptoprocne zonaris. White-collared Swift. On July 2 first one, then two or three, of these large swifts began to appear over the golf course at Changuinola, their numbers slowly increasing until at least fifty were in the air at once, about 11 a.m. The swifts seemed to come from the mountains toward the west, but their circling flight, a glide alternating with rapid wing beats, made this somewhat uncertain. In the afternoon of July 3, more than half way to Almirante, in a much larger flock of small *Chaetura* swifts, perhaps ten of the White-collared Swifts were flying. *S. zonaris* is generally a highland species in Middle America, but the birds descend to nearby lowlands, perhaps only for feeding.

Chaetura cinereiventris. Gray-rumped Swifts. Flocks of small *Chaetura* swifts ranging from ten to a hundred birds were intermittently noted over all localities. A few flew sufficiently low to show the gray rump and anterior underparts that contrasted with the blackish back and lower ventral region, a contrast diagnostic of this species; this is the only *Chaetura* that has been collected in the Almirante Bay area.

Phaethornis superciliosus. Long-tailed Hermit. One in the forest near Changuinola.

Chlorostilbon canivetii assimilis. Fork-tailed Emerald. Two males seen feeding at flowers in dooryards at Bocas del Toro village on July 4. I give the trinomial because some authors do not regard *assimilis* as a race of *canivetii*, while Zimmer would treat all the Middle American, blue-tailed members of *Chlorostilbon* as races of the South American *C. mellisugus* (1950:5–12).

Amazilia tzacatl. Rufous-tailed Hummingbird. The most numerous hummingbird about Chan-

guinola, Almirante, and Bocas del Toro village. I must have seen over thirty, a large number, considering that they are solitary and that there was no local concentration. This is one of the commonest hummingbirds in cleared areas and gardens throughout the lowlands of Panamá, but nowhere else have I found it so numerous. At Bocas del Toro one was sitting on a twig calling continuously for minutes at a time a fast *tsip-tsip-tsip-tsip*, on and on, at the rate of 12 *tsips* per 5 seconds. Sometimes the call was accelerated so as to sound like a trilling rattle.

Chloroceryle americana. Green Kingfisher. One on the San San River and another in mangroves over salt water at Almirante.

Malacoptila panamensis. Whiskered Puffbird. Three together in the remnants of rain forest near Changuinola on June 30; one was a very rufous bird.

Dryocopus lineatus. Lineated Woodpecker. One in the rain forest giving a flicker-like call.

Centurus pucherani. Black-cheeked Woodpecker. Two at the edge of the rain forest near Changuinola.

Lepidocolaptes souleyetii. Streak-headed Woodcreeper. Two in trees at the border of the residential compound at Changuinola.

Synallaxis brachyura. Slaty Spinetail. A pair in the bushes among tall grass on a dike bordering a dry impoundment, across the road from the Changuinola golf course. When alarmed they gave a nasal *cheep* or *nyup* and disappeared in shrubbery.

Myrmotherula axillaris. White-flanked Antwren. The characteristic descending *pee-a, peh-a, pü-a* was repeatedly heard in the trees of the rain forest remnant near Changuinola on June 30.

Formicarius analis. Black-faced Antthrush. In the woods the familiar, clear, mournful whistle repeatedly came from the forest floor. The basic call consists of an easily imitated phrase, a long note followed by two shorter notes about a half tone lower than the first. This phrase is given at intervals of 15 to 20 seconds. Often the shorter note is repeated three or four times. Occasionally the phrase consists of the single higher note followed by a repetition of the shorter lower note as many as eight to ten times, and Major Francis O. Chapelle writes me that in the Canal Zone in April, doubtless near the start of the breeding season, he has counted the second note of the phrase reiterated sometimes as many as fifteen times.

Attila spadiceus. Bright-rumped Attila. While I did not see this arboreal cotinga in the forest remnant near Changuinola, I heard its unmistakable loud whistle, *whit, whit, weéda, weéda, weedoooo*. The attila, considering its size, is often hard to see, for it frequently perches in the foliage near the trunk.

Colonia colonus. Long-tailed Tyrant. One perched on a slender dead tree in partly cleared, burned-over second growth adjacent to the railroad, on the way to Almirante, on July 3.

Tyrannus melancholicus. Tropical Kingbird. Common in open areas throughout. In this area exceeded in number among the Tyrannidae only by *Pitangus*. Seen chasing *Buteo magnirostris* at Bocas del Toro.

Megarynchus pitangua. Boat-billed Flycatcher. One seen giving its almost kingfisher-like rattle at the edge of the forest adjacent to a marshy pool on June 30.

**Legatus leucophaius*. Piratic Flycatcher. One calling from a tree near the Bocas del Toro airstrip on June 29. The piratical behavior of *Legatus*, harassing certain birds that build closed nests until they abandon, and often discarding several such nests before settling on one for its own brood, has been well described (Chapman, 1929:111–121; Skutch, 1944:253) although not fully understood. Once its voice is known, a complaining *weé-yee*, sometimes followed by *piririree*, the species is found to be well-distributed, although solitary, along wooded roadsides, in clearings, forest edge, and other open areas where large trees exist, up to at least 5200 feet. This covers the habitats of its favored Panamanian victims, which are not only the large colonial icterids, but especially the abundant flycatcher *Myiozetetes similis* and the becard *Pachyramphus cinnamomeus*, both of which build large globular nests. When calling, *Legatus* selects a post at or near the top of a tall, foliaged tree, where it has an open view, but where, although the perch itself may be bare, the bird is hard to distinguish from the ground. One at Pedro Miguel, Canal Zone, used the very tip of the unfurled leaf spike of a lofty royal palm for its "song" perch.

Myiozetetes similis. Social Flycatcher. One of the commonest flycatchers of clearings, edge and even fairly dry open country, provided there be trees for nesting. An occupied nest, a roughly globular structure, conspicuous on a tree branch, was found on July 2 at Changuinola.

Myiozetetes granadensis. Gray-capped Flycatcher. This species appears to require more humid conditions than are needed by *M. similis*, but wherever in Panamá I have found *granadensis, similis* also has been present. In the citrus orchard within the residential compound at Changuinola there were at least two pairs. They called *chip, kew-kew* or *kip, kew-kew* and also *kip-kip* and *kew-kew*.

Pitangus sulphuratus. Great Kiskadee. The most conspicuous and widely distributed passerine about Changuinola, Almirante, and Bocas del Toro. It fed on the ground as well as in the air. A few could always be seen on the grass of the golf course, and I saw one catch a small lizard at the edge of a pool. They were noisy all day. The basic call seemed to be a loud, vibrant, slightly nasal, *keep-career*, or *geep-coweer*, sometimes *keep-careéw*. One common call was a long-drawn, more nasal *geeeep*, or *keeeup*, or *keeeew*. At times it may alternate the two-syllable *keep-weeer* with a three-syllabled *keep-coweér*, or repeat one phrase several times before giving a variation. I found two occupied nests, large and globular, located with no attempt at concealment; one was on a telephone cross bar, the other on the open limb of a tree. Considering the species' wide neotropical range from southern Texas to Argentina and its abundance in cleared and cultivated areas throughout Central America and northern South America, its very limited distribution in the Republic of Panamá is surprising. Hitherto it has been recorded only from the Almirante Bay area (Griscom, 1935:348). In December of 1955, James E. Ambrose, Jr., a youth living in the Canal Zone, began writing me that he believed this species was present in the Canal Zone about the Caribbean terminal city of Colón. On June 19, 1956, Ambrose showed me two individuals, unquestionably *P. sulphuratus*, at New Cristóbal, a suburb of Colón. Ambrose reports the bird from a number of localities near the Caribbean coast in the Canal Zone, and even a little to the east at María Chiquita. That this is a recent range extension seems certain, for the many collectors who have visited or lived in the area could hardly have overlooked so conspicuous a species. So far as I know, this kiskadee has not yet been observed inland in Panamá, but that it will in time pass over to the Pacific side of the Canal Zone is to be expected. It remains to be ascertained by collecting whether the birds of the Canal Zone are the Central American race found in Bocas del Toro (*guatimalensis*) or the Caribbean Colombian form (*rufipennis*).

Myiarchus tuberculifer. Dusky-capped (Olivaceous) Flycatcher. A pair regularly seen in the orange orchard within the residential compound at Changuinola.

Contopus cinereus brachytarsus. Tropical Pewee. Two were noted in the orange trees at Changuinola on July 2. The trinomial is given because some students have doubted whether the Middle American form is really conspecific with the Brazilian *C. cinereus*. In Panamá the Tropical Pewee, unlike its northern ally *C. virens*, is not a forest bird. It frequents clearings, the edge of second growth, road borders, orchards, and even small trees in savanna countries. While at times perching on high exposed branches, this pewee is more often seen rather low on small dead trees or dry bushes. The only call I have noted is a slightly burred or trilled *pee-ee*.

Todirostrum cinereum. Common Tody Flycatcher. This is a common species in orchards, gardens and clearings throughout Panamá. I noted it at Changuinola and at Almirante. In appearance and behavior it is somewhat suggestive of a gnatcatcher (*Polioptila*), as it nervously hops about shrubbery and low trees, with tail uptilted. In addition to fanning and closing the tail, and pumping it up and down, this species has a special trick of describing an arc from side to side by a slow movement of the uplifted tail. While feeding, chiefly by gleaning, it gives a loud single *tsip*, repeated at irregular intervals of perhaps five or six seconds. At times a more rapid series of *tsips* is uttered. The song is a loud trill lasting usually about half a second and repeated with pauses of from three to four seconds; sometimes it is louder and higher, uttered at intervals of about a second. The trill suggests that of the Ferruginous Pygmy Owl (*Glaucidium brasilianum*), but is shorter, louder, and more musical.

Tyranniscus vilissimus. Paltry Tyrannulet. Its characteristic and persistent *peeeyick* or *chee-yip* heard at the edge of the forest on June 30; also seen in the tree border of the residential compound. This widely distributed little bird favors the lower trees at the edge of forest and woodland. It gleans in foliage, but sometimes it flies out to hover before a leaf, with extremely rapid wing beats, as it picks off small insect prey. I have also seen it eat the tiny berries of a tropical mistletoe.

Progne chalybea. Gray-breasted Martin. Numerous over Changuinola and Almirante.

**Phaeoprogne tapera*. Brown-chested Martin. Flying with the resident martins at Changuinola were several of this South American species; one was carefully studied on June 30. The migratory southern race *fusca* has proved to be an abundant, regular visitant in central Panamá during the

southern hemisphere winter (Eisenmann, 1955*b*). This is the farthest northwest that *Phaeoprogne* has been recorded, but I feel sure it will be found to migrate well into Central America. Its flight differs from *Progne*, being slower, with a peculiar fluttering character.

Hirundo rustica. Barn Swallow. One seen perched on June 30 and on July 1 at Changuinola, at localities about a mile apart; but the same individual perhaps was involved. Barn Swallows are such abundant migrants in Panamá that an occasional laggard is not surprising. On June 28, 1952, John L. Bull and I saw one at Fort San Lorenzo, Canal Zone. James Ambrose, Jr., writes that he observed two on July 23, 1956, at Coco Solo, Canal Zone; this seems a little early for fall migrants, which ordinarily begin to appear in the second week of August.

Iridoprocne albilinea. Mangrove Swallow. Perhaps thirty of these little low-flying swallows were noted over the flooded impoundment at Changuinola, a few were seen skimming over the San San River, and some were found near Almirante. Despite their name, in my experience they are most numerous about fresh water, although they do occur about mangroves, generally near the mouths of rivers.

Psilorhinus (*morio*?) *mexicanus*. White-tipped Brown Jay. Several small groups were noted in the forest near Changuinola. Why the range of so aggressive a bird as the Brown Jay should end at Bocas del Toro is puzzling. It cannot be competition with other jays, for the only widely distributed jay in Panamá is the smaller *Cyanocorax affinis*, which is not a really numerous bird.

Thryothorus zeledoni. Cane-brake Wren. This species was heard singing in the tall cane-like grass at the edge of a dry impoundment at Changuinola on June 30 and July 1. I noted one song as a loud, ringing *chowereét, chowereét, chowereét*, repeated over and over, and another as *chicheéwee, chicheéwee, chicheéwee*. Hellmayr (1934:170) treats this local form, which is found from Caribbean Nicaragua to Bocas del Toro, as conspecific with the wide-ranging Plain Wren (*T. modestus*). The latter is found from México to central Panamá. The southern part of its range is restricted to the Pacific slope, except in Panamá where it has crossed to the Caribbean in the clearings of the Canal Zone. It is likely that before long *T. modestus elutus*, the Panamanian race, will extend northeast along the clearings of the Caribbean coast to overlap the range of *zeledoni*. The preferred habitat of these forms seems somewhat different; *elutus* is commonly found in garden shrubbery about houses, where I failed to find *zeledoni* at Changuinola. The songs I heard of *zeledoni* were different from any I have noted from *elutus*, but they showed some resemblance. Caution is indicated as to "lumping" sedentary tropical wrens, merely because they are closely allied "representatives." The Middle American *T. modestus* is represented in South America by the very similar *T. leucotis* group, yet in central Panamá there is a zone where subspecies of each are fully sympatric, although ecologically segregated, without any evidence of interbreeding.

Troglodytes musculus. Southern House Wren. I noted only one at Changuinola.

Turdus grayi. Clay-colored Robin. Common in cleared areas throughout. About the dwellings at Changuinola and Almirante, this robin was the first bird heard singing before dawn; it also sang intermittently through the day, particularly in the late afternoon. Its song closely resembles that of the American Robin, *T. migratorius*, although one of its calls is very different (Eisenmann, 1952:48). The Panamanian race (*casius*) seems not as confiding as *migratorius* and is less terrestrial, but where lawns are maintained, as at Changuinola, it feeds regularly on the ground.

Vireo flavoviridis. Yellow-green Vireo. Heard singing in the Changuinola residential compound on July 1. In Panamá it especially favors clearings, gardens, orchards, and low second growth. In forested areas it appears to be restricted to "edge." It seems to me convenient to regard it tentatively as a species distinct from the North American *V. olivaceus*, even though a derivative of the same stock, for this also is true of the West Indian *altiloquus* group, which no one lumps.

Hylophilus decurtatus. Gray-headed Greenlet. A small group was seen and heard in the forest near Changuinola. While favoring the foliage of the higher trees in the forest, this species drops down lower when feeding at forest borders. In addition to various chittering calls, the song strongly suggests a short two- or three-note phrase of the Yellow-green and Red-eyed vireos, but instead of then proceeding to another phrase, this greenlet repeats the same phrase over and over, usually, however, with pauses of two seconds or more between repetitions. I have noted the following variations in its whistled, monotonous song, *tsitseeweé*, or *tsitseetreét* or *itsacheét*; also there is a two-noted *tsiweét* or *chwee-chweet*; occasionally the phrase is a doubled *tsitseeweét-tsitseesweét*.

Coereba flaveola. Bananaquit. A few were seen in trees growing near doorways at Almirante and at Bocas del Toro on July 3 and 4.

Geothlypis semiflava. Olive-crowned Yellowthroat. Many individuals of both sexes were flushed, in Changuinola, from the rank grass and shrubbery growing along the dikes bordering both flooded and dry impoundments.

Gymnostinops montezuma. Montezuma Oropendola. Small groups often flew over Changuinola or perched in the forest; also this species was noted on the outskirts of Bocas del Toro. This Middle American species seems to reach its regular southern limit in this area, although there are a few records from the Caribbean coast of the Canal Zone. Its call notes, which included a harsh *kzweck*, somewhat resemble those of the more widely distributed Chestnut-headed Oropendola (*Zarhynchus wagleri*). Despite differences in the extent of the facial feathering and shape of the frontal shield, their general behavior, the structure of their colonial nests, and their voices indicate that the oropendolas are split into too many small genera.

Amblycercus holosericeus. Yellow-billed Cacique. This thicket inhabitant was noted in a swampy part of the woods near Changuinola. It differs strikingly in nest and behavior from the other birds called "caciques" (Skutch, 1954:281).

**Tangavius aeneus*. Red-eyed Cowbird. Panamanian records of this Middle American species are very few. It was therefore interesting to find an adult male perched on a roadside telephone wire near the flooded impoundment on June 30. Peter Hogaboom, who identified the bird before I mentioned its name, said he had seen this species repeatedly about Changuinola. Carriker (1910:832) did not collect it in the adjacent low country of Costa Rica, so perhaps this species is a fairly recent invader.

Icterus prosthemelas. Black-cowled Oriole. A male of this rather pallid icterid, which also reaches its southern limit in this area, was noted perched on a banana plant in a large plantation at Changuinola on June 30.

Icterus mesomelas. Yellow-tailed Oriole. This widely-distributed oriole was frequently seen in the trees about the residential area and particularly the bamboo thickets bordering roadside drainage ditches around Changuinola; also it was noted in trees bordering the San San River. In Panamá it is definitely not a forest bird (Griscom, 1935:372) but favors damp, fairly open localities, particularly near water, keeping rather low for an *Icterus*. On June 30 one was carrying a caterpillar into a bamboo thicket, probably to its young. It utters a variety of melodious, ringing whistles. One loud phrase, heard at Changuinola, consisting of from three to five notes, was repeated so often that until I saw the bird I supposed it to be some kind of wren. Less musical calls I have recorded as *chup-cheet*, also *chup-chup-cheet*, and *weéchaw weéchaw*. Skutch regards the Yellow-tailed Oriole as one of the outstanding Central American vocalists (1954:263).

Tangara larvata. Golden-masked Tanager. A pair was seen at the edge of a banana plantation at Changuinola, and another on a tree near the residential area. Skutch has given a good general account (1954:200) of the behavior of this beautiful tanager, as observed in Costa Rica and on Barro Colorado Island. The ordinary call I would syllabize as *tsit-tsit-tsit-tsit*. The song is a weak, dry, rapid trill of about one second's duration, too fast to distinguish syllables, but perhaps suggested by *tsiririririririt*. It somewhat resembles the trill of a Chipping Sparrow (*Spizella passerina*), but it is shorter and weaker. This species shows great variety in its nesting sites in Panamá. While the small open cup is usually placed in the crotch of tree branches, one pair on Barro Colorado Island built in the concavity formed by the curving fruit of a growing bunch of bananas; and another, east of Panamá city, used an old woodpecker hole in a dead tree. On August 22, 1954, on Barro Colorado Island I saw a Golden-masked Tanager enter the deserted, pendent bag nest of an oropendola (*Zarhynchus wagleri*); that night a storm blew down the nest, which contained two fresh eggs of the tanager. An opening had been developed just above the widest part of the bag, so that the incubating tanager did not have to descend through the long neck.

Contrary to Hellmayr (1936:127), it seems to me preferable to follow Ridgway (1902:47–50) in treating the intergrading golden-headed races of *larvata* (from southern México to western Ecuador) as a species distinct from the blue-headed *nigro-cincta* (tropical South America east of the Andes), although the ranges do not overlap. Most recent authors have uncritically followed Hellmayr. Zimmer, although conceding that Hellmayr offered "a rather broad arrangement, since *larvata, fanny*, and *franciscae* [the golden-headed forms] are closer together than the three are to *nigro-cincta*," felt that the four forms constituted at least a "superspecies," and concluded that "there is advantage in expressing this relationship which, in a system of trinomial nomenclature, can only be done by referring them

to a common specific unit" (1943:13). But not every relationship below the level of the genus needs to be expressed in the scientific name; relationships above that level also can not always be thus indicated. The binomial is intended to indicate substantial biological identity in the present rather than common ancestry in the past. To use the same binomial for all members of a superspecies destroys the distinctive function of the species name. "The species name signifies singularity and distinctiveness, the generic implies the existence of similar or related units" (Mayr, 1943:138). A general policy of lumping in one species groups of forms deemed "representative" may conceal striking differences of biological importance, and also it may obscure relationships within the groups. Granted that the test of reproductive isolation cannot be directly applied to geographically separated forms, inferences may be drawn by comparing the degree of morphological difference associated with reproductive isolation in other species of the same genus. The very plumage pattern shared by *T. larvata* and *T. nigro-cincta* characterizes the *T. cyannicollis* group of western Amazonia and the Andean slopes from Venezuela and Colombia to Bolivia. Subspecies of *T. cyannicollis* are sympatric with *T. larvata* in western Ecuador and with *T. nigro-cincta* east of the Andes (Zimmer, 1943:12–14). *T. nigro-cincta* resembles the *T. cyannicollis* group and differs from the *T. larvata* group in its entirely blue head and more conspicuous blue wing-edgings. While in *nigro-cincta* the head is a pale violaceous blue and in the *cyannicollis* group a more greenish turquoise blue, most races of *cyannicollis* have a violaceous tinge on the throat and some on the forecrown as well. Moreover the golden head color of *larvata* seems to me closer to the turquoise of *cyannicollis* than to the violaceous of *nigro-cincta*. The *larvata* group and *nigro-cincta* are alike in having a white median area on the lower breast and abdomen. In the *cyannicollis* group the black of the breast-band and the blue of the sides and flanks have expanded to cover the ventral area; but even here *nigro-cincta* in its deeper blue flanks shows an approach to *T. cyannicollis cyanopygia* of Ecuador. If, despite its obvious derivation from the same stock, *T. cyannicollis* can maintain its reproductive isolation from both *T. larvata* and *T. nigro-cincta* where their ranges overlap, why should it be assumed that the latter would freely interbreed were their ranges to meet? Presumably there has been no genic interchange between them since the Andes were uplifted. Other sympatric species in the genus *Tangara* show differences less striking than those characterizing the birds here discussed. *Tangara lavinia* and *T. gyrola* share the same color pattern, the former being found only in Central America and west of the Andes, the latter chiefly, but not wholly, east of this range. The only "specific" character of the *lavinia* group is the rufous (as distinct from greenish) margins to the wing feathers. Yet from Costa Rica to western Ecuador the two close allies appear to be sympatric. Even more similar to each other are the *T. punctata* and *T. chrysophrys* (or *guttata*, if Cabanis' name be accorded priority, as Wetmore believes [*cf.* Hellmayr, 1936:100]), which overlap in parts of South America.

Thraupis episcopus. Blue-gray Tanager. A common bird about the residential area of Changuinola, Almirante, and Bocas del Toro; this is probably the most abundant and widely-distributed tanager in Panamá. It favors clearings, edge, and even open country if there are a few trees present. At Changuinola on July 2 at 5:15 p.m., in a period of heavy overcast, 16 Blue-gray Tanagers, 4 Palm Tanagers, 1 Scarlet-rumped Tanager, 1 Golden-masked Tanager, 1 Clay-colored Robin, and 1 Great Kiskadee were perched in one thinly foliaged tree. They were quiet but dispersed when it began to rain.

Thraupis palmarum. Palm Tanager. More common than the Blue-gray Tanager at Changuinola and Almirante, but very similar in behavior and basic habitat. It seems to require better tree growth and is absent from the drier and more open areas, as well as the higher country. The activity of these birds about the Almirante coconut palms suggested nesting.

Ramphocelus passerinii. Scarlet-rumped Tanager. The commonest tanager about Changuinola; noted also near Almirante and Bocas del Toro. *R. p. passerinii* is another wide-ranging Middle American bird that reaches its southern limit in Bocas del Toro. It is a resident of shrubbery and low trees in cleared areas of rather humid country. Although I must have seen at least thirty adult male Scarlet-rumped Tanagers during my stay, I heard nothing that resembled a song. I heard a male frequently call *wheet-chee* from a small tree; females gave a harsh *chuck*, and males also uttered chucking notes. It seems strange that the local Pacific slope form, *costaricensis*, ranging only from southwestern Costa Rica to the adjacent Panamanian province of Chiriquí, should be, according to Skutch (1954:124), a most persistent and rather pleasant singer. Immediately to the east, reaching Panamá from northwestern South America, the similarly patterned Yellow-rumped Tanager (*R. icteronotus*) is found. A slight overlap of *icteronotus* and *passerinii* is reported in eastern Bocas del Toro (Peters, 1931:341). If this

situation is maintained, it would show how representative populations of obviously common ancestry, one developing in Middle America, the other in northwestern South America, may prove to be good species when their ranges actually meet. One behavior difference I have noted is that *passerinii* readily accepts the vicinity of houses for nesting whereas *icteronotus* remains a shyer bird.

Tachyphonus rufus. White-lined Tanager. Several pairs were about the Changuinola residential compound. The birds usually keep low in roadside shrubbery and small trees and are ordinarily found in pairs; the rufous female makes an interesting contrast to the black male with its flashing white wing-linings.

Saltator maximus. Buff-throated Saltator. A shy bird, even though common among the thick growth of orange trees in the residential area and also in roadside shrubbery and bamboo thickets at Changuinola and Bocas del Toro. In the early morning of July 3, one was in the open perched on a tree singing a sweet, oft-repeated *cheeareét-chwéyou*. A frequent call note was a thin *seeeep*.

**Sporophila torqueola*. White-collared Seedeater. This species has never before been reported from Panamá, but the Central American race *morelleti* proved to be fairly common about Changuinola, particularly in the tall grass growing on the top and on the slopes of the impoundment dikes. First recognized on June 30, these seedeaters were noted daily thereafter along roadsides and about the edge of the golf course. I saw at least thirty, mostly white-collared adult males, but I also noted a number of females and immatures, including two juveniles and one mottled male with much buff below, which was singing as well as an adult. Presumably this species has extended its range rather recently, for it was not recorded by the collectors working at Bocas del Toro in the 1920's, and its presence in the area is not mentioned by Skutch in discussing its range (1954). Carriker (1910:887) did not find it even in the adjacent Caribbean lowlands of southeastern Costa Rica, although he regarded it as common in the highlands, on the Pacific slope, and on the northern Caribbean coast of that country. About Changuinola this bird associated with the larger and much commoner Black Seedeater, *S.* (*aurita*?) *corvina*. It was interesting to make comparison of its song with that of *corvina*, and of the nominate *aurita* (absent from this area), which I had been hearing daily prior to June 29 about Panamá city. The song is very different from either. It is slower, richer and sweeter, lacking the hurried, twittering effect of those birds. The fullest version I heard lasted about four seconds: *swee-swee-swee-swee-swee, teéoo-teéoo-teéoo, tew-tew-tew-tew* (these last notes very canary-like). Variations were *swee-swee-swee-teéoo*, and *swee, tew-tew-tew-tew, too-too-too-too-too*. Shorter forms were *swee-swee-swee, tew-tew-tew* and *twee, tew-tew*. Adult males strikingly resembled light-type males of *S. a. aurita*. Some even showed black on the throat; but they could be distinguished by white edges to the wing-coverts and secondaries which sometimes formed a wing-bar. Females were conspicuously different from *aurita* and *corvina* in their clear buff underparts and definite white or buffy wing-bars.

Sporophila (*aurita*?) *corvina*. Black Seedeater. The most abundant bird in grassy places at Changuinola, Almirante, and Bocas del Toro. Many hundreds were seen, for the birds are gregarious feeders. Males were heard singing freely. My notes describe the song as rapid and rather twittering, usually lasting between 3 and 4 seconds: *chirrechirrecheéwee, chirrechirrecheéwee, chirree-chirr-cheéwee, cheéwee*. Sometimes in place of the last phrase there is a closing *chirr*, or the song may end irregularly. I wrote the calls heard as *seeyp, tseeyp*, and *tsiwee*. Although the song is generally pleasant, some utterances were so thin and wiry as to seem unmusical.

The song resembled that of the Variable Seedeater (*S. a. aurita*) of the Canal Zone, but it seemed to me more hurried and less sweet. Accurate comparison would require mechanical recording of many samples, but some indication of the difference to my ear may be suggested by what I wrote as to the song of *S. a. aurita* on Barro Colorado (1952:58): "A sweet, rapid, twittering, somewhat canarylike *tsiwee tsiwee tsiwee, chee chee chee, twee-twee-twee-twee, chirr chirr chirr chirr*, with variations, the chirrs often omitted." In song, as in color, *S. a. aurita* appears intermediate between *morelleti* and *corvina*, although the song is nearer to the latter.

Hellmayr (1938:189), and most subsequent authors, treat *corvina* as a subspecies of the black and white *S. aurita*. This may well be correct, for *corvina* is certainly the representative, on the Caribbean slope of Central America, of the same stock that in northwestern South America produced *S. aurita*, which ranges northward over the Pacific slope of Panamá into Costa Rica and reaches the Caribbean coast in the Canal Zone area. In the comparative amount of black and white, the male of the nominate *aurita* is a variable bird throughout its range, particularly in and about the Canal Zone,

where some individuals show considerable approach to the all-black *corvina*. The Colombian race, *S. aurita ophthalmica*, consistently shows more white. The variability of Panamanian birds suggests the introgressive effects of possible interbreeding between *aurita* and *corvina*, although it was already apparent in specimens taken a century ago when these forms were probably not in contact. No one has reported both *corvina* and *aurita* from the same locality, but it is possible that nominate *aurita* is itself the product of some earlier contact between *corvina* and a population essentially like *ophthalmica*. But this is not necessarily the case, for there is a noticeable melanistic tendency in other species of the genus. Thus *S. torqueola morelleti* produces, particularly in Pacific Guatemala, some males that are so extensively black on the throat, chest and rump (so-called "*mutanda*") as to be almost indistinguishable from the usual Canal Zone *S. a. aurita* (Griscom, 1930:7; Hellmayr, 1938:188). These blackish individuals occur chiefly where both *corvina* and *aurita* are absent, so it is unlikely that they represent hybridization of *morelleti* with either of these darker forms. The prevalence of all-black color in *corvina* may have been developed by selection as an isolating mechanism to prevent mixing with the allied, but the widely sympatric *S. torqueola* group, which, although found now in the Caribbean habitats of *corvina*, probably originated on the more arid Pacific slope where *corvina* is absent. If black color is one of the mechanisms keeping *corvina* from interbreeding wth *S. torqueola morelleti*, the question arises whether it will so serve as against the darker *S. aurita*, now that clearing of forest is bringing them in contact. *Corvina* is a remarkably uniform bird throughout its long range from southern México to western Panamá, but I did see one male at Changuinola that appeared to have a faint suggestion of white on the sides of the neck, perhaps indicating infiltration of *aurita* blood. Dr. Wetmore states (*in litt.*) that in 1952 he collected only *corvina* at the Boca del Río Indio, Colón province, some twelve miles west of the Canal Zone. The approaching contact in Panamá between *corvina* and *aurita* invites field work to determine whether they react to each other as to the same species. The result would be prejudged by presently calling *corvina* a race of *aurita*. De Schauensee has recently proposed lumping the *aurita* group (including *corvina*) as races of *S. americana* of eastern South America (1952:169). Curiously enough *S. americana* resembles the distant smaller *S. torqueola morelleti* (rather than the *aurita* group) in having white wing edgings. Before accepting de Schauensee's proposal in a group where very similar birds may be good species, it would be well to know whether *S. americana* sings like *aurita* or like *morelleti*, or whether it sings differently from either.

Oryzoborus funereus. Thick-billed Seed-finch. Fairly common in roadside thickets and in the tall grass of the impoundment dikes at Changuinola. This species, although fond of grass seed, is more arboreal than the species of *Sporophila*, perching on the top of trees when singing. Its song is a very sweet warble that often lasts 8 to 12 seconds without a pause.

Volatinia jacarina. Blue-black Grassquit. Common in dry grassy areas at Changuinola, usually associated with *Sporophila corvina* and *S. torqueola*.

Arremonops conirostris. Green-backed Sparrow. A shy bird, but very common in bushy areas at the edge of the residential compound at Changuinola, about the dikes surrounding both flooded and dry impoundments, and in roadside thickets there and at Bocas del Toro. At 6 a.m. on July 3 I saw one in a tree calling, over and over, an unfamiliar *weet-cheh*. The local subspecies (*richmondi*) to my ear sang somewhat differently from that of the central Panamanian race, *lafresnayi*. The song of both consists of a similar accelerating series of notes, but the notes of *richmondi* seemed less full and ringing, and they usually began with a *cheeup*. I have never heard from *richmondi* the "bob-white" whistle so often given by *lafresnayi*, and Skutch (1954) does not mention it.

SUMMARY

In June and July, 1956, a visit was made to western Bocas del Toro, the Caribbean province of Panamá bordering on Costa Rica. Some thirteen species were observed which had not been previously recorded from the province, one being new to the Republic of Panamá. Notes are given on distribution, song and behavior in Panamá of many of the species observed. The Bocas del Toro area is especially interesting because a number of Central American species here reach their southern limits and are replaced farther to the southeast in Panamá by their South American representatives. Increasing clearing of forest is bringing the "edge" forms into contact, providing a natural laboratory for studies in speciation. The taxonomy of various species occurring at Bocas del Toro is

discussed, and the suggestion is made that two rather than one species of *Jacana* be recognized, that the *Tangara larvata* group be treated as a species distinct from *T. nigrocincta*, and that the relations of *Thryothorus modestus* with *zeledoni* and of *Sporophila aurita* with *corvina* require further study before their conspecificity is assumed.

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American Museum of Natural History, New York, New York, February 17, 1957.

INCUBATION BY DRAKE WOOD DUCK IN ECLIPSE PLUMAGE

By NOBLE ROLLIN

In a summary of the behavior of surface-feeding ducks, Kendeigh (1952:186–187) states that the male usually "deserts the female after incubation gets well under way" but he also reports that this is not always so. For instance in *Aix* "the male is more faithful and may aid the female in caring for the young." Nevertheless it is quite abnormal for the drakes in *Aix* to incubate. Savage (1952:48) speaking of the Mandarin (*Aix galericulata*) says that "the drake takes no part in incubation," while Leopold (1951: 215) in his careful study of nesting Wood Ducks (*Aix sponsa*) states "I have never seen the drake incubate the eggs. In fact, I have never seen the drake enter the nesting box at any time." The following note about a Wood Duck drake, which not only incubated eggs but did so in eclipse plumage, may therefore be of interest.

During the last week of June, 1955, a pair of Wood Ducks, at the World Bird Research Station at Glanton, Northumberland, England, deserted their second nest shortly after incubation had begun. At the beginning of the second week in July, when the drake of this pair was already passing into eclipse plumage, it was seen going onto the deserted eggs occasionally. By mid-July this had become more regular and it was noticed that it was usually in the afternoons that the male incubated the eggs. There was the possibility that it may also have stayed on the eggs over night on July 14–15. The bird by this time was almost in full eclipse plumage; it had dropped its flight feathers and the only breeding plumage remaining consisted of a few bright feathers on its head. After each period of incubation the drake covered the eggs carefully with the down which the duck had provided when it originally laid the eggs. On July 17 the drake deserted the eggs, leaving them uncovered and exposed. On July 19 it began periods of incubation again, covering the eggs once more on leaving, as it had done previously.

On July 20 a continuous series of all-day watches were begun and were continued until the bird finally gave up incubation. This was on July 26. After this date the drake was never seen to take any further interest in the eggs. It might be added that the duck, which accompanied the drake when it was off the eggs, had taken no interest in the eggs since the original desertion. The results of the all-day watches are shown in figure 1; the dark bars represent the periods when the bird was incubating.

Leopold (1951:214) states that normally the duck leaves the nest twice a day for periods from forty minutes to two hours. In the morning it leaves often "as early as an hour before sunrise when there is just a faint sign of dawn in the East." The approximate time at which this light appears is shown in figure 1 as "faint light." The position of sunrise is also shown. (The time from faint light to sunrise is longer in the higher latitude of Northumberland than in Iowa.) It will be seen that on the three occasions when the drake incubated overnight, it left the nest in the morning at the same time as ducks normally leave or are off the nest. In the evening the duck "usually departs between five and six o'clock and returns before seven," which latter time in Iowa is a little before sunset. Again it will be seen in figure 1 that in the three instances where the drake went to incubate in the evening it did so a little before sunset. It appears then, that in the main, the drake was observing the normal "duck" night incubation period. Whereas all incubating ducks are back on the nest within one to two hours of sunrise, the drake was very tardy in returning to the eggs. As already mentioned it was not until the afternoon that he was usually seen to go onto the nest and in two of the first three all-day watches it was still early afternoon before incubation was begun. However, in the second three all-day watches he returned in the forenoon. The earliest he returned to the eggs

was at 9:09 a.m. on July 25, when he remained on the eggs less than half an hour. The latest return was at 1:37 p.m. on July 22 when the bird remained on the nest until the following morning. On July 26 there was no attempt at daytime incubation; the bird went on the nest for the night period a little before sunset.

The periods on the eggs, commencing with the observations on July 20, were as follows: 20th, 11:16 a.m.–4:22 p.m.; 21st, 12:29–2:52 p.m.; 22nd–23rd, 1:37 p.m.–3:02 a.m.; 23rd, 10:31–11:06 a.m.; 23rd–24th, 7:42 p.m.–4:13 a.m.; 24th, 10:24 a.m.–4:38 p.m.; 25th, 9:09–9:33 a.m.; 25th–26th, 7:37 p.m.–2:53 a.m.; 26th, 7:56–11:42 p.m. This gives the maximum incubation period as 13 hours and 25 minutes (July 22–23). The average for 9 periods was 5 hours 18 minutes. The bird spent a total of 47 hours and 40 minutes on the eggs in a week.

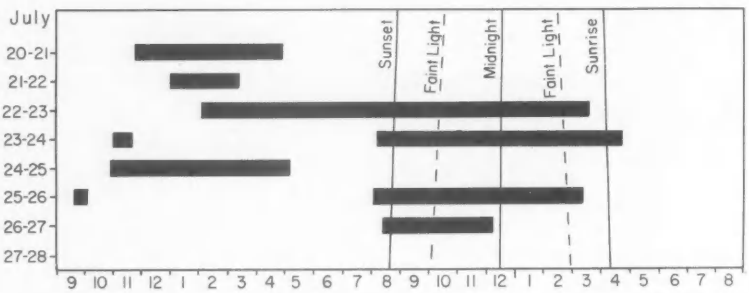

Fig. 1. Incubation periods of drake Wood Duck, shown by dark bars; the last incubation period ceased near midnight on July 26.

Although not concerned with ducks, Ryves (1943:10) has called attention to the fact that, in many species where males do not normally incubate, they may occasionally cover the eggs in the absence of the female. This behavior is characterized by the bird sitting "on eggs without the production of the requisite temperature to further their development" and by the periods on the nest being irregular and haphazard. He points out that this is not incubation and gives an instance of eggs being still almost cold after a male had covered them for more than half an hour. The Wood Duck drake not only covered the eggs but it also incubated them in the true sense of the word. Thus the eggs were warm after it had been on the nest; it normally replaced the down coverlet when leaving the eggs, and, however imperfectly, it appeared to be attempting at least a regular night incubation period.

The Wood Ducks were a pair kept for observation in an area of about three-quarters of an acre. The nest, in a wooden nesting box with a side entrance, was one which the drake investigated as a suitable nesting place for the second clutch. Originally the box had the hole facing upward and each time the drake went in it had to be liberated, as the hole was too small for the bird to jump out when it opened its wings. When it was certain that the drake was choosing this as a nesting place, the box was put on its side. The duck was never caught in the box in its original position, which makes it certain that it was the drake and not the duck which chose this nesting site. Both birds had partly clipped wings so that their flight was not full. Throughout the period of continuous observation, and for a time before this, the drake was completely flightless due to the normal total loss of flight feathers during eclipse. The bird gained access to the nest

by means of a log onto which it climbed. The birds found much of their food naturally in the area, which was mixed scrub and grass around a pool. They were also fed wheat bread and waste seeds.

Leopold (1951:215) remarks that "the duck evidently has no automatic release which prevents her from continuing to incubate eggs which are no longer alive," and he mentions a very bad odor from some broken eggs in the case of a duck which had sat for 62 days. The drake Wood Duck was similar in this respect. On July 25 one of the eggs burst while the drake was incubating. The drake leaped from the nest with his breast feathers smeared with odorous decaying egg. He went off to bathe. The remaining eggs (four) had to be washed and the nest cleaned. In spite of this the drake was back on the nest again in the evening. Originally there were seven eggs, but two were removed after the first desertion in June, leaving five until the egg just mentioned broke.

The pair of Wood Ducks had been in the Station at Glanton for over five years and up to 1955 had behaved normally. They behaved normally again in the succeeding year. The only known difference in the environment of the ducks in 1955 was that the summer was, for England, exceptionally hot and sunny, with a drought. In previous years the duck had several times deserted eggs and these, covered with down, had remained for long periods, at least up to September, in the nest. The presence of deserted eggs was therefore not new to the drake.

All the times given above relative to the Wood Duck at Glanton are in local apparent time, that is, time by the sun at the place of observation.

SUMMARY

A drake Wood Duck incubated deserted eggs in July when in eclipse plumage. It incubated during a "night"-time period similar to that recorded for normal female incubation. Its day-time incubation, however, was relatively fragmentary and commenced either late in the morning or early in the afternoon, instead of very early in the morning as recorded for normal female behavior.

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World Bird Research Station, Glanton, Northumberland, England, February 8, 1957.

FROM FIELD AND STUDY

Selection and Emberizine Distraction Display.—Savannah Sparrows (*Passerculus sandwichensis*) and Song Sparrows (*Melospiza melodia*) are abundant inhabitants of *Salicornia* salt marshes in coastal California. In the course of field work conducted between 1950 and 1955 on a population of Song Sparrows (Johnston, Condor, 58, 1956:24–44; 254–272), I had opportunity to observe nesting behavior of these two finches. One of the major behavioral differences in the breeding season between the two is that the Savannah Sparrow almost always exhibits a marked distraction display when flushed from eggs or young, whereas the Song Sparrow almost never so displays. Since the position of the nest is related to the occurrence of distraction display, it should be noted that the salt marsh Savannah Sparrow is consistently a ground-nester whereas the salt marsh Song Sparrow nests in low bushes about ten inches off the ground.

It seems general that ground-nesting birds show some type of distraction display, and the adaptive advantages are clear. My notes show I flushed *Passerculus* 23 times and recorded distraction displays 17 times. This seems to place the distraction display of salt marsh Savannah Sparrows within the range of normality known for the whole species. In passing I should mention that this species flushes from its eggs in the same manner as it does from nestlings; the relative importance of incubating and parental drives involved in releasing distraction display would thus appear to be nearly the same. Armstrong (Ibis, 98, 1956:641–654) notes much variation in importance of the two component sets.

Birds that nest off the ground are less often seen to give distraction display, apparently for reasons having to do with the distance of a predator or the alarm stimulus received at the nest when flushing occurs. *Melospiza* may be considered normally an above-ground nester over much of its distributional range; however, on salt marshes it must nest in situations that approximate ground nesting. Under these conditions I recorded one instance of distraction display out of approximately 130 possible times it might have been given. On an unknown number of other times Song Sparrows merely stole from the nest quietly and unobtrusively. The instance of distraction display, rather than headlong flight, occurred in the following way: the bird had built its nest only four inches from the end of a stranded log that was 18 to 20 inches in diameter; this log formed a pathway clear of surrounding *Salicornia*. It was to this log and along it that the Song Sparrow ran, using the "rodent run."

Thus, in broadly equivalent nesting situations on *Salicornia* marshes, we see in one finch the persistence of distraction display and in the other its absence in favor of headlong flight or stealthy removal.

If it may be assumed that the existence of distraction display in birds is due to a particular configuration within the species genotype, the following hypotheses may be considered: (1) Distraction display is not advantageous to salt marsh Song Sparrows or it is merely of neutral adaptive value, with no selection for or against it. (2) Distraction display is of adaptive advantage to salt marsh Song Sparrows but the selective factor has not yet caused the display to appear phenotypically in any significant portion of the population.

Were the first hypothesis valid, we would be left mainly with a fact that in the salt marsh environment, distraction display is not useful to Song Sparrows. If the second hypothesis were valid, we should inquire into the forces of selection and the genetic process. The selective factor would be mortality caused by the dominant predator on salt marshes, the Norway rat (*Rattus norvegicus*). There is no way now of assessing the strength of rat selection against headlong flight as opposed to distraction display. Presuming such selection to exist, in time a significant number of appropriate alleles will be found in the population. But why are they not now found?

The answer probably lies with the time factor (see, for example, Dobzhansky, Genetics and the Origin of Species, 1941:220). Norway rats have been present on Californian salt marshes probably for less than 150 Song Sparrow generations. This is an exceedingly short time in an evolutionary sense, and especially so in view of the large breeding populations that these birds maintain.—RICHARD F. JOHNSTON, *Department of Biology, New Mexico College of Agriculture and Mechanic Arts, State College, New Mexico, February 1, 1957.*

A Fossil Rail from the Pliocene of Arizona.—For several years Dr. Allan Phillips and others have made periodical examination of a fossil deposit attributed to the Upper Pliocene, located on the Gray Ranch, near Wikieup post office, Mohave County, in northwestern Arizona. This has yielded a number of bones of birds. Among these is the tarsometatarsus of a medium-sized rail that has been placed in my hands for study and that proves to be a species hitherto unknown. The description is as follows:

Rallus phillipsi sp. nov.

Characters.—Tarsometatarsus (fig. 1) generally similar to that of the living Clapper Rail (*Rallus longirostris* Boddaert) but definitely smaller, being intermediate in size between that species and the living Virginia Rail (*Rallus limicola* Vieillot); compared with *Rallus longirostris,* fourth trochlea relatively smaller; middle trochlea, viewed from the outer side, narrower.

Total length 47.4 mm., transverse breadth across head 5.6, transverse breadth at center of shaft 3.2, transverse breadth across trochlea 5.9.

Fig. 1. Type of *Rallus phillipsi,* × 0.5.

Type.—Right tarsometatarsus, collection of Allan R. Phillips no. L.135 (on deposit in the United States National Museum), collected in April, 1952, complete except for the tendinal loop on the upper anterior end of the shaft below the head.

Remarks.—The new species is larger than *Rallus prentici* Wetmore from the Upper Pliocene of Meade County, Kansas, this being the only other rail of its genus with which it needs direct comparison, except for the two living species mentioned above; remains of both living species have been found fossil in Pleistocene deposits. In some of its characters *Rallus phillipsi* approaches the genus *Porzana,* as represented by the living *Porzana carolina* (Linnaeus), suggesting a closer affiliation of this genus with *Rallus* through the species that lived during the latter part of the Tertiary. The bird here described, however, may be placed in *Rallus* since it agrees with *Rallus longirostris* and *Rallus limicola* and differs from *Porzana* in the definitely greater posterior projection of the second trochlea and the greater and more open gap between the distal end of this segment and the base of the third trochlea.

The type of *R. phillipsi* is light grayish white in color and is well fossilized. Although the area of the head is slightly porous, suggesting an immature bird that has only recently attained its growth, the appearance throughout is such as to leave no uncertainty as to full development of the characters that mark the adult stage. The drawing illustrating it is the work of Lawrence B. Isham of the Department of Geology in the United States National Museum.

The species is named for Dr. Allan R. Phillips in recognition of his detailed studies of the living species of birds found in Arizona.

In an earlier note (Condor, 45, 1943:120) I reported a broken coracoid of a large swan as *Cygnus* sp. from this same deposit near Wikieup. At that time it was supposed that the beds concerned were of Miocene age, but further observations have placed them in the Pliocene. This correction relative to the swan specimen should be noted. In this connection Dr. Phillips informs me that further swan

material from this quarry seems to represent the subgenus *Sthenelides*. It is probable that the earlier, badly preserved specimen may belong in this same group.—ALEXANDER WETMORE, *Smithsonian Institution, Washington, D.C., January 9, 1957.*

Bay-breasted Warbler off California Coast.—On the morning of October 6, 1956, a specimen of the Bay-breasted Warbler (*Dendroica castanea*) was obtained 24 miles south-southeast of San Clemente Island, almost due west of San Diego, California. This location is out of sight of any land mass, and the bird, after circling the ship for approximately ten minutes, attempted to land. The crew of the vessel, a commercial chartered fishing craft, indicated that it was not uncommon to find small land birds off the coast, and that "many were picked up and released when they returned to port." This bird, following unsuccessful attempts to land on the rigging, slipped into the water and was netted by the crew.

The specimen, now number 134974 in the collections of the Museum of Vertebrate Zoology, was checked for identification by Dr. Harrison B. Tordoff. The bird is an immature, as shown by the plumage, having only a faint suffusion of buff on the breast, and by the skull, which was only partly ossified. It was a male, and it was considerably emaciated.

No reference can be found to the occurrence of this warbler in the western United States, although numerous reports are available concerning vagrant warblers taken or seen at sea near the California coast and on the Channel Islands off southern California. It would seem most likely that passerine birds would appear away from shore during conditions of unusual wind velocity. At the time the Bay-breasted Warbler was taken, there was no storm, nor had there been high winds. The bird was alone; no other passerines were observed on this particular day.

One must concede that, particularly among migrants, the mortality is great because of straying from regular migration routes. Grinnell (Auk, 34, 1922:373–380) discusses such vagrants carefully, and we can but conclude with him that this Bay-breasted Warbler was a "pioneer . . . sacrificed in the interests of the species."—M. DALE ARVEY, *Long Beach State College, Long Beach, California, February 20, 1957.*

Blue and White Swallow in México.—On May 24, 1954, Alvarez collected a swallow from a mixed flock of *Petrochelidon fulva* and *Progne chalybea* which was roosting within a building in Tuxtla Gutiérrez, Chiapas, México. The bird was presented to the Museum of Comparative Zoology (no. 280768), where it was identified as an immature example of the Blue and White Swallows, *Atticora cyanoleuca patagonica*; the race involved breeds from Bolivia southward and winters to the north. The specimen has light-colored underwing coverts and its crissum is white with the longest feathers tipped with the dusky—characters which unequivocally distinguish *patagonica* from the other races.

Howell (Condor, 57, 1955:188–189) recently found this swallow in Nicaragua; his record at the time was the most northern station for this form, which commonly winters north to Colombia and Panamá. The addition of a record from México suggests that *patagonica* may be a regular migrant north of Panamá. If this is true, the specimen from Tuxtla Gutiérrez would seem to represent the longest known migration of a South American non-marine species, although, of course, some stray birds have travelled even farther.—RAYMOND A. PAYNTER, JR., *Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts,* and MIGUEL ALVAREZ DEL TORO, *Instituto Zoológico del Estado, Tuxtla Gutiérrez, Chiapas, México, November 30, 1956.*

Translocated Golden-crowned Sparrows Return to Winter Range.—On February 4, 1956, several Golden-crowned Sparrows (*Zonotrichia atricapilla*) were trapped and banded in a residential garden at San Jose, California. After acclimatization to cages they were shipped by commercial aircraft to Pullman, Washington, on February 14 for use in studies in the physiology of avian migration. On March 6 they were placed in individual activity-recording cages designed to determine their 24-hour activity patterns. The cages were exposed to the weather on the roof of the Science Building on the campus of the State College of Washington. By accident, two birds escaped from their cages on March 19 and one on April 4.

On December 1, 1956, Golden-crowned Sparrows were again trapped in the same residential garden at San Jose. Among them were the two which escaped at Pullman on the previous March 19. The escapee of April 4 has not been seen.

The air-line distance from San Jose, California, to Pullman, Washington, is approximately 700 miles. Pullman is more than 150 miles east of the usual route of migration. Jewett, Taylor, Shaw, and Aldrich (Birds of Washington State, 1953:650–651) state that the Golden-crowned Sparrow is a very common spring migrant west of the Cascade Mountains, but eastern Washington is off the main route of migration; in fall the principal mass of migrants apparently moves south along the Cascade Mountains where they seem to prefer the west slope. During several years of netting of *Zonotrichia* in the vicinity of Pullman, only six Golden-crowned Sparrows have been taken, while more than a thousand White-crowned Sparrows were handled. The southernmost known breeding area of the Golden-crowned Sparrow is at Harts Pass in the Cascade Mountains of Okanogan County, Washington (Farner and Buss, Condor, 59, 1957:141).

It may be noted that the two birds escaped four to six weeks prior to the time their flock mates at San Jose started their northward migration. "*Zugunruhe*," or migratory restlessness, in the birds caged at Pullman, began to develop about April 10 and became well marked about April 27.—L. Richard Mewaldt, *Department of Biological Sciences, San Jose State College, San Jose, California,* and Donald S. Farner, *Laboratories of Zoophysiology, The State College of Washington, Pullman, Washington, January 25, 1957.*

The Cattle Egret in Jamaica, British West Indies.—On a visit to the Bodles livestock experiment station in Jamaica on November 21, 1956, more than 20 Cattle Egrets were seen feeding, in typical fashion, among the steers on an experimental pasture. Bodles is on the low-lying plain on the south side of Jamaica, not far from the town of May Pen. The elevation is estimated at about 50 feet.

Dr. T. P. Lecky, of the Jamaican Department of Agriculture, who was showing us the station, remarked that the birds had appeared about 10 days previous, and that he had never before seen white herons feeding in among the cattle in this fashion. He and Mr. Tom J. Jackson of St. Croix, who were familiar with the white immature Little Blue Heron, were quick to see the difference in heaviness of head and neck and in leg color when these were pointed out.

This sight record is offered because I am thoroughly familiar with the birds in St. Croix, and because I regard it as serving to fill in the range rather than to extend it; the species has been collected in Cuba (Sprunt, Bull. Mass. Audubon Soc., 40, 1956:65–69) and the Virgin Islands (Seaman, Wilson Bull., 67, 1955:304–305), and it is common in Puerto Rico (letter from James Bond to G. A. Seaman, March 4, 1955).—R. M. Bond, *Kingshill, St. Croix, U. S. Virgin Islands, December 3, 1956.*

Precocial Strutting in Sage Grouse.—The annual strutting display by male Sage Grouse (*Centrocercus urophasianus*) in March and April provides game managers with a handy and apparently reliable index to population trends. During the past three years of management-research investigations I have spent 75 early morning periods observing these activities on more than 120 different strutting grounds.

Therefore, it was with considerable surprise that I observed the unmistakable strutting display by a Sage Grouse that was estimated to be about eight weeks old. This incident occurred just after sunrise, along Chicken Creek, 6460 feet elevation, on Sunflower Flat, 11 miles southeast of Mountain City, Elko County, Nevada, on July 14, 1956. The bird was one of a group of about 10 young birds and 4 adult hens.

All phases of the strutting display were observed, including the fanned tail, the three or four shuffling steps forward, the forward wing thrust, and even an attempted pumping of non-existent air sacs. The display was directed toward an adult hen and the whole episode lasted about 15 or 20 seconds, with no observed preliminary or subsequent display.

This precocial behavior of this very young Sage Grouse is particularly interesting when one recalls that immatures of the species are still very inept at strutting when about 10 months old. Apparently they do not regularly participate in this courtship display until their second year (Patterson, The Sage Grouse in Wyoming, 1952:143).—Gordon W. Gullion, *Nevada Fish and Game Commission, Austin, Nevada, January 7, 1957.*

Some Additions to Nesting Data on Panamanian Birds.—In 1956 I found nests of four species of birds in the Province of Chiriqui, Panamá, which provide evidence that extends the known breeding season of these forms.

Amazilia edward niveoventer. Snowy-breasted Hummingbird. A new cup-shaped nest of this species was located in a small tree eight feet from the ground on March 14 about 4500 feet above sea level outside of the village of Volcán. The measurements were: outside diameter, 48 mm.; outside depth, 45; inside diameter, 22; inside depth, 24. The outside was decorated with moss and red and greenish lichens. The body and lining were composed of fine brown plant fibers. The bird was collected. Skutch, without describing the nest, gives dates for this species for November and December (Ibis, 1950:202) in Costa Rica.

Fig. 1. Nest holes of Streak-breasted Tree-hunter (*Thripadectes rufobrunneus*), near village of Volcán, Panamá, March 1, 1956.

Lampornis castaneoventris. White-throated Mountain-gem. A nest of this species was found on February 16, at 6800 feet on Mount Copete above the village of Boquete. This nest was in a bush next to a trail overlooking a considerable drop into a valley. It contained two very small young. The dimensions were: outside diameter, 59 mm.; outside depth, 59; inside diameter, 27; inside depth, 20. A large amount of moss made up the outside and there were very few lichens on the upper part of one side. The inner body and lining were composed of fine brown plant fibers. The female bird was collected. Skutch mentions nesting in January, February, April and July (Ibis, 1900:200) for this species but he was concerned with a different race and he did not describe the nest.

Selasphorus scintilla. Scintillant Hummingbird. A deep cup-shaped nest of this species was obtained at 7000 feet above sea level on Mount Copete on February 10. It was located on a knoll in a bush about 5 feet high surrounded by other bushes and trees. The dimensions were: outside diameter, 43 mm.; outside depth, 55; inside diameter, 18; inside depth, 15 to 18. The nest was composed of fine downy white fibers which also served as a lining. The outside was plastered with lichens and some moss. One fresh egg was found in the nest. The female was collected. Blake described the nest and eggs of this species collected in the same area in November and December (Condor, 58, 1956:386–387).

Thripadectes rufobrunneus. Streak-breasted Tree-hunter. On March 1, 1956, nest holes (fig. 1) of this species were discovered in a cut made by a logging road on the side of a forested hill about 4500 feet above sea level outside of the village of Volcán. There were two holes twelve inches apart and seven feet above the road in soft volcanic soil. Each hole was four inches wide by three and one-

half inches high. The tunnel on the right containing the nest was twenty-six inches long, being expanded at the rear to a chamber six inches in diameter in which a thick nest of rootlets (fig. 2) had been placed. The latter contained two, much incubated pure white eggs measuring 20.30×31.34 mm. and 20.80×30.80. Four days before the nest hole was investigated, the male bird flew out of the nest hole and was collected. Just before the nest was uncovered four days later, the female was watched for a short time. It was first seen as it flew into the hole. In six minutes it came to the entrance. After a few minutes there, it left to return to a nearby branch a little later.

Fig. 2. Nest and eggs of Streak-breasted Tree-hunter (*Thripadectes rufobrunneus*) removed from tunnel.

The left hand hole was about ten inches deep and had no enlargement. It may have been a "trial" hole. Whether it was used for roosting was not learned.

Worth described the nest and eggs of this species taken on August 4 near Boquete (Auk, 56, 1939:306). Underwood collected eggs on May 9 and 28 (Ogilvie-Grant, Cat. Coll. Birds Eggs Brit. Mus., 5, 1912). Worth found his incubating bird to be a male. In our birds, evidently the male had been incubating when the holes were first discovered, while at the second visit the female was incubating. Whether normally the sexes take turn about in incubation we do not know.

Eugene Eisenmann kindly furnished some of the references used in this note.—FRANK A. HARTMAN, *Department of Physiology, Ohio State University, Columbus, Ohio, April 10, 1957.*

NOTES AND NEWS

S. Dillon Ripley, Secretary of the Pan-American Section of The International Committee for Bird Preservation, writes that he has just received a very welcome report from the Japanese Association for the Protection of Birds stating that due to their activity on Torishima Island both predator control and prevention of human interference have gone forward, and the Island has been declared a Reservation. As a consequence three young of the Short-tailed Albatross (*Diomedea albatrus*) were reared there in the season of 1955–56, and eight young have been seen in the current season. The previous count of adults only in 1954 was 23.

COOPER SOCIETY MEETINGS

SOUTHERN DIVISION

MARCH.—The monthly meeting of the Southern Division of the Cooper Ornithological Society was held on March 26, 1957, at the Los Angeles County Museum. The following names were proposed for membership: John Bowles, 1424 Kentucky St., Lawrence, Kans., James G. Purinton, 720 Branham Lane, San Jose 23, Calif., and Mrs. Clyde Stewart, P.O. Box 535, Leucadia, Calif., by Jack C. von Bloeker, Jr.; Dr. Joseph T. Bagnara, Dept. Zoology, University of Arizona, Tucson, Ariz., Robert H. MacArthur, R.F.D. No. 1, Newfane, Vt., and Crystal Yarding, 1220 E. 4th St., Tucson, Ariz., by Joe T. Marshall, Jr.; Mrs. John Chaney, 932 Tiverton Ave., Los Angeles 24, Calif., Bernard A. Forrest, 1105 San Ysidro Dr., Beverly Hills, Calif., Charles Albert McLaughlin, L. A. County Museum, Los Angeles 7, Calif., and Chris Parrish, 4515 Don Tonito Ave., Los Angeles 8, Calif., by Kenneth E. Stager; David G. Marqua, 421 St. Louis Ave., Long Beach 14, Calif., by M. Dale Arvey; W. Plass Owen, Box 516, Chula Vista, Calif., by Mrs. Laura Bailey; R. H. Barth, Biological Lab., Harvard University, Cambridge 38, Mass., Donald F. Bauman, M.D., 1306 Ridge View Terrace, Fullerton, Calif., James F. Bendell, Dept. Zoology, University of British Columbia, Vancouver 8, B.C., Canada, Frank Christensen, 7037 Alvern St., Los Angeles 45, Calif., J. V. Crockett, 115 W. 12th St., Long Beach 13, Calif., Mrs. Arthur S. Gasche, 1297 N.E. 103 St., Miami Shores 38, Fla., H. Warren Harrington, Jr., 19 Holborn St., Milton 86, Mass., Dr. Stuart Houston, Box 278, Yorkton, Sask., Canada, Chester E. Kebbe, 5414 N.E. Emerson St., Portland 13, Ore., Richard L. Kleen, Church Neck Rd., St. Michaels, Md., Mrs. John W. Le Sassier, 1611 West Indiana, Midland, Tex., Dale Miller, 14826 S. Lime Ave., Compton 2, Calif., Mrs. Madge Olson, Apt. 2, 25 E. 9th Ave., Denver 3, Colo., Sally Smith, Poughkeepsie High School, Poughkeepsie, N.Y., Floyd B. Seiter, 59124 Main St., New Haven, Mich., and Gerard Frederick van Ters, % Dept. Zoology, University of British Columbia, Vancouver, B.C., Canada, by C. V. Duff.

"Hamburgers, Hawks and Gopher Holes; the Biology of the San Joaquin Experimental Range in the Foothills of the Sierra Nevada," was the subject of speaker Henry E. Childs, Jr. His talk was illustrated with Kodachrome slides.—DOROTHY E. GRONER, *Secretary*.

NORTHERN DIVISION

JANUARY.—The monthly meeting of the Northern Division was held at the University of California on January 3, 1957. Mrs. W. F. Lamoreux, R.F.D. Box 518, Niles, California, was proposed for membership by Junea W. Kelly.

L. R. Mewaldt, Chairman of the Nominating Committee, proposed the following slate of officers for the Division for 1957: President, Donald McLean; First Vice-president, John Davis; Second Vice-President, A. Starker Leopold; Secretary, Lillian K. Henningsen. Alden H. Miller moved that the nominations be closed and that the Secretary cast a unanimous ballot for the nominees; motion carried.

Miller reviewed the new book, "Natural History of Birds," by Leonard Wing, and recommended it as a serious and useful general text.

Field observations included the following: Howard Cogswell reported that on December 28, 1956, 5000 Sandhill Cranes were seen flying northwestward at a height of 800 feet above the Los Baños Refuge in a ten-minute interval between 4:10 and 4:20 p.m. Gordon Orians reported that a Swamp Sparrow was found during the New Year's Day bird count on Tomales Point.

Donald McLean presented the program of the evening, speaking on "Big Horn Sheep and Some Birds of Deep Springs Valley, Inyo County" and illustrating his talk with excellent motion pictures.—HARRIET P. THOMAS, *Acting Secretary*.

For Sale, Exchange, and Want Column—Each member of the Cooper Society is entitled to one short advertising notice in any issue of the Condor free. Notices of over 3 lines will be charged for at the rate of 25 cents per line. Send advertising copy to Jack C. von Bloeker, Jr., Los Angeles City College, 855 N. Vermont Ave., Los Angeles 29, California.

FREE—Thorne, Differences between the Common House Finch and Cassin Purple Finch of the Genus *Carpodacus* (Bull. No. 3), and A Solenoid Mechanism for Springing Bird Traps (Bull. No. 4). —OAKLEIGH THORNE, II, *Thorne Ecological Research Station, 1707 Hillside Rd., Boulder, Colo.*

WANTED—Adult male Peregrine Falcon scientific study skin and mounted specimen. Any reasonable price will be paid for these two specimens in good condition for use at our institution.—HENRY E. CHILDS, JR., *Cerritos College, Norwalk, Calif.*

FOR SALE—Auk, 1930 to date; Bird Censuses and Audubon Field Notes, 1939–56; Condor, 1925 to date; Wilson Bulletin, 1931 to date; Bent, Life Histories, U.S.N.M. Bulls 113, 121, 130, 135, 142, 146, 162, 167, 170, 174, 176, 179, 191, 197; Ridgway and Friedmann, Birds of North and Middle America, I–VIII (bound), IX–XI (paper covers).—FLORENCE HAGUE, *Dept. Biology, Sweet Briar College, Sweet Briar, Va.*

WANTED—Ridgway, Birds of North and Middle America, I–VII; Ridgway, Manual of North American Birds. Please state price and condition.—JAMES R. WERNER, *P. O. Box 145, Goodyear, Ariz.*

ORNITHOLOGISTS—Do you know why wearing a hat may help you see birds more clearly through binoculars? Read our new article: "Getting More from Your Binocular," in the Audubon Magazine, March-April, 1957. Also, send for reprints of our earlier Audubon Magazine articles: "Know Your Binoculars"—how to choose the "right" model for your personal requirements, check it for the claims made for it, and use it to best advantage, a 12-page booklet, 10¢ (no charge to C.O.S. members); and "How to Check Alignment," free. If your binocular does not give clear and restful vision, send it to us; we clean and align to U. S. Government tolerances in one week. If you need a new binocular, send for our price list of American, German, and Japanese binoculars, 3 grades with quality comparison, including 6 models modified in our shop especially for bird study. Every glass, irrespective of price, is covered by our one-year free-service guarantee. We ship on 30 days' trial; send for details. If you have a binocular problem, let us help you solve it. We answer questions personally.—THE REICHERTS, *Mirakel Optical Co., Mount Vernon 15, N.Y.*

FOR SALE—Separate issues and complete volumes of W.B.B.A. News from Bird-banders available at reasonable prices. The News has completed 30 years as a quarterly journal and has an important place in ornithological literature. Write for list of available issues and prices.—EMERSON A. STONER, *Western Bird-Banding Association, 285 East L St., Benicia,* Calif.

FOR SALE—"Summer Birds of the Rincon Mountains, Saguaro National Monument, Arizona," by Joe T. Marshall, Jr., with color plate of the Olive Warbler, reprinted from The Condor, vol. 58, pp. 81–97, $1.00, postpaid.—THOMAS R. HOWELL, *Assistant Business Manager, Cooper Ornithological Society, Dept. Zoology, Univ. Calif., Los Angeles 24, Calif.*

FOR SALE—The "Tiny Tucker" Hummingbird Feeder, new, improved model, complete with instructions for use, $1.20, including postage. California residents please add 4% state tax.—TUCKER BIRD SANCTUARY, *Box 53, Star Route, Modjeska Canyon, Orange, Calif.*

FOR SALE—An Annotated Bibliography of North Dakota Ornithology, paper cover, $1.00, postpaid.—WILLIAM F. RAPP, JR., *430 Ivy Ave., Crete, Nebr.*

PREPARATION OF MANUSCRIPTS FOR THE CONDOR

Articles published in the Condor normally are written by members of the Cooper Ornithological Society. Practically all the Society's money goes into the journal; no editor or business manager receives any pay other than the satisfaction of doing a service worthily. The preparation of good copy by the author will contribute greatly to accuracy of published output, dispatch in handling, and economy of production.

To be acceptable for inclusion in the Condor, articles must not duplicate in any substantial way material that is published elsewhere. Any type of subject bearing on birds may be considered; but the geographic areas of primary concern are western North America, Central America, and the Pacific Basin. Manuscripts may be sent to the editors at the Museum of Vertebrate Zoology. Proofs with edited manuscripts will be sent to authors, at which time reprints may be ordered.

In the interests of accuracy and economy, observe the following: do not duplicate data in text, tables, or charts; check citations to original sources and verify text references; quoted statements must be exact replicas of the original; preferably use vernacular names applicable to the entire avian species (for a guide in this regard, see "The Distribution of the Birds of California," Pac. Coast Avif. No. 27, 1944:5–34); in general, avoid subspecific vernaculars; insert scientific names for species but not the subspecific name except in taxonomic papers or where the race concerned has been critically determined by the author or his collaborators; revise the manuscript repeatedly to remove superfluous words and phrases, immaterial detail, and repetitious statements.

Note Condor style and usage. "General Articles" and the "Field and Study" items are set up in different form. Provide a concise, meaningful title, and, where needed, subtitles within the text. Footnotes are not used. The address line may serve to indicate institutional connection, and to it should be added the date of transmittal of the manuscript. Terminal bibliographies are desirable where five or more titles are to be cited; otherwise, the references may be included in the text. For bibliographic style, note closely the practices employed in recent volumes of the journal. A factual summary is recommended for longer papers.

Rules for copy.—(1) Typewrite material, using one side of paper only; (2) double space all material and leave liberal margins; (3) use 8½ × 11 inch paper of standard weight (avoid onion skin); (4) carbon copies are not acceptable; (5) place tables on separate pages; (6) number pages in upper right hand corner.

Illustrations.—Photographs should be glossy prints of good contrast. Make line drawings with India ink; plan linework and lettering for at least ½ reduction; do not use typewritten labels on the face of the drawing. Provide typed legends on separate sheets.

Helpful references on writing: Manual of Style, University of Chicago Press, and Rules of the Editorial Committee, University of California Press. On scientific nomenclature: A.O.U. Check-list (with supplements 19 through 30) and Pacific Coast Avifauna No. 27; authors are not required to follow either of these works.